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A Monthly Popular Journal of Knowledge

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A Monthly Popular Journal of Knowledge

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Editorial Notes.

One of the worst troubles associated with writing about war is that a large number of people who avoided their responsibilities during the war write hysterical letters to you about it. This leads to a natural avoidance of the subject. People do not like to be written to by a lot of well-meaning neurasthenics and a perceptible percentage of traitors, internationalised aliens and a general precipitate of the unfit. The only conscientious objectors who earned anybody's respect during the war were the Quakers. Their young men, and even old men, were out at the front and in action with the Friends' Ambulance long before conscription was passed. They were or rather some of them were at the very first gas attack that occurred the beginning of the second Battle of Ypres on the 22nd April, 1915—the birthday of chemical warfare. They did magnificent work and showed a vain disregard of danger and a stressed conception of duty that endeared them for ever to the fighting troops. The fact that these were men of great spirit does not necessarily involve the acceptance of the bulk of objectors who sheltered behind the genuine few. In order to avoid disappointment, let me say here and now that I do not intend to answer any letters on this subject. Life is too short to worry about other people's complexes unless one is a professional psycho-analyst.

The problem of chemical warfare is one that affects you and I—and our children. It is one of those things that one shirks thinking about. The traditional tactics of the ostrich do not, however, lead to a perpetuation of the species. Admitting the manifold imperfections of our own race, I must at the same time confess that acquaintance with other races of humanity has not persuaded me that humanity in general would benefit by our extermination or our elimination as a predominant influence in world progress. The situation in regard to chemical warfare is very closely similar to the disturbing condition of affairs that occurred in the early fourteenth century when gunpowder and *crakys of war* were first employed in Europe. The armour-plated chivalry protested with considerable bitterness. Moralists headed by the Church condemned and even excommunicated the innovation and the innovators but, nevertheless, gunpowder had come to stay. It is very deplorable but one can imagine the hard-bitten sensible old knight of the period saying to his altruistic clerical friends: "I agree, this villainous saltpetre ought to be stopped—but look at the crossbow! Why, in my young days do you think that any decent commander who set a value on his reputation as a knight would have had a string of Burgundian arbalistiers in his company? Yet to-day—why, everybody has them. We cannot afford to disregard the arm!"

* * * * *

The historians, the scientists of the record of human development and achievement, give cold comfort if you ask them what peaceful mirage of the future may be read in the mirrors of the past. War, so far as all recorded history is concerned, is the normal rather than the abnormal condition and, according to tradition the infernal regions are paved with good intentions. The facts as we face them to-day are briefly that chemical warfare cannot be controlled by pacts or mutual bonds agreed on in peace-time or imposed by victory on unreliable defeated races. The intelligent use of a new weapon looked on by contemporary authorities as a wicked and unsportsmanlike device

has in history proved an efficient help to victory by small nations, and it is not likely that any responsible national leader deciding to submit an issue to the ultimate decision of arms is going to forgo the use of such a valuable asset. Chemical warfare is perhaps visualised by the man-in-the-street as that languid cloud of chlorine which, driven by a favourable breeze, rolled down as choking death into our trenches in the salient in '15. This picture is wrong. Modern chemical warfare is far more serious than that. It is a secret weapon, a devil's surprise. A weapon which can be prepared secretly. It requires little specialized training in its use and developments may result in new lethal combinations which may for a time profoundly modify the whole of the old mechanism of warfare, defensive and offensive, whose strategy and tactics alike are dependent on the employment of a missile weapon and the eventual corps á corps combat. Not only our late enemies but other powers are profoundly aware of the potentialities of the new arm. It is not being neglected by them.

* * * * *

No less an authority than Professor Arthur Smithells, F.R.S., has recently drawn the attention of the public to the need for vigilance on the part of our military authorities (*The Times*, Nov. 13, 1924, p.15). He utters grave words of warning against half-measures. There have been other equally authoritative voices raised on the same subject since. In all that concerns gas warfare and, in particular, counter-gas measures, it is vital that we should be adequately equipped to hold our own in any war directed against us. There is no question of a gas scare for, as we well know, scientific counter-measures at the end of the war had reduced gas casualties to some two per cent of the total casualties; while in the earlier stages they were as high as twenty-five per cent. Further work on counter-measures has been done and so far as known lethal gases are concerned the danger ratio has been still further reduced. There is, however, always a possibility of the discovery of a new gas, a very little of which applied to the civil population would produce calamitous moral effects quite out of proportion to the real military value of the discovery. The danger of turning a blind eye to chemical warfare is that the military authorities may be intimidated into departmental cowardice and calamitous economics. The cranks who attack them are doubtless acting on the highest moral grounds, but had we listened to the same kind of people in the past we should be down and out to-day. We live in unstable times when the most far-seeing of statesmen admit that at any unforeseen moment war clouds may blow across the face of Europe from the East. We are no longer an island. This is perhaps the only really important thing—and a peculiarly unpleasant thing, that our much-boomed scientific conquest of the air has achieved. International arbitration is a splendid thing, but until it is established we must encourage our chemists and foster those chemical industries which, useful in time of peace, become vital in time of war. Chemical warfare is certainly extremely unsporting, but surely the last decade should have taught even the most chuckle-headed cavalry officer that war is not a sport.

* * * * *

This is our Xmas number and you will note that we do not give you a suitable free plate to hang on the laboratory wall, nor have we made special efforts to be Christmassy. We do recommend ourselves as a Christmas present though. The journal represents better value for those people who actually read (as distinct from those who simply look through the pictures) than anything else on the bookstall. I will let you into a further secret. We sell extremely well in Scotland. This is no mean accomplishment, for the Scots are a discriminating people and know a good thing when they see it. Their verdict helps me to recommend the paper with every confidence. I might be prejudiced—they know! There are several points about giving a year's subscription to DISCOVERY as a present. It means twelve successive presents, it is just about the right price, it lasts out the whole year and there are sure to be some good articles in every issue which afford a lively basis for discussion.

* * * * *

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* * * * *

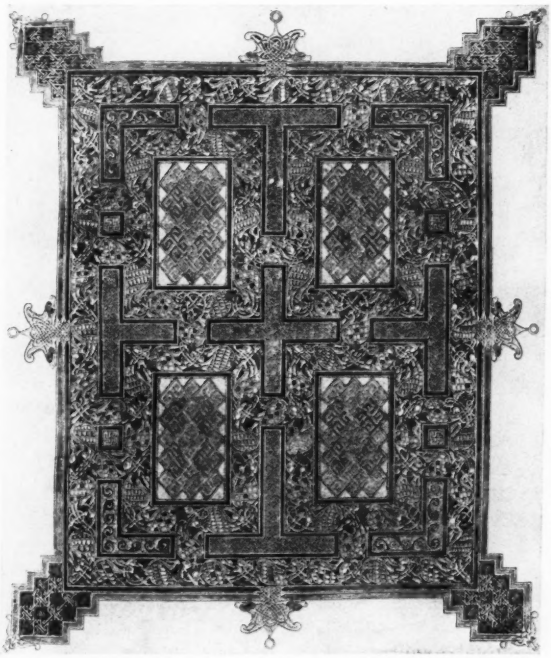
I again want to thank all those who have so kindly sent in the names and addresses of further potential subscribers. In every case copies have been sent. We have not yet reached that eminently desirable point where everyone who should read DISCOVERY does. Nothing like it. Nevertheless, there has been a steady regular upward growth in subscriptions and sales both at home and abroad, and I hope you will keep up the effort.

English Paintings in the Middle Ages—I.

By Sir Frederic Kenyon, K.C.B., F.B.A.

You have probably been taught to believe that there is little English art prior to the eighteenth century, and that we are an essentially inartistic country. Sir Frederic Kenyon, who is Director of the British Museum, shows in this series of articles how English art has on the other hand a long record of first-class work from the seventh century onward.

It is a common superstition, especially on the Continent, that England is and almost always has been an inartistic country. England is supposed to have had no native school of painting of first-class merit before Hogarth, and its contribution to the artistic achievement of the world is regarded as being confined to the portraiture of Reynolds, Gainsborough, Romney, Lawrence, Hoppner and Raeburn, the landscape school of Gainsborough, Crome, Turner and Constable, and its water-colourists from the Norwich school downwards. Before Hogarth it is usual to assume that all the best work in England was done by foreign artists.



LINDISFARNE GOSPELS, f. 210.

Last autumn, through the initiative and financial support of Lord Lee of Fareham, an attempt was made to remove this reproach by an exhibition of English Mediaeval Paintings which was held at Burlington House; and the admirable introduction by Mr. W. G. Constable to the catalogue of this exhibition is probably the best existing guide to the subject. Nevertheless, for reasons which appear in this introduction, it may be doubted whether the exhibition fully succeeded in its object. The paintings shown were curious, interesting, sometimes impressive; but the number of works which could be classed as first-rate was small. Partly this was due to the fact that several fine paintings cannot, for material reasons, be removed from their original positions; but the main reason is the immense destruction of paintings, both mural and detached, which took place at the time of the Reformation and the Puritan Revolution. Mr. Constable describes the fatal activities of the Commissioners of Henry VIII and Elizabeth in the sixteenth century, and of William Dowsing, "Blue Dick of Thanet," and other servants of the Parliament in the seventeenth, and it has to be realized that in this way literally thousands of paintings disappeared without leaving any record of their merit; while "neglect in the eighteenth and enthusiastic restoration in the nineteenth" centuries have reduced the material within yet narrower limits. The history of English mediaeval art can never be complete, because all but an infinitesimal fraction of its paintings on walls and panels have disappeared.

One section, however, of the painter's art escaped in great measure from this wholesale destruction, namely, the paintings in manuscripts. Mediaeval manuscripts of English as well as of continental origin have come down to us in considerable numbers; and if we are to form any just opinion of the quality of English painting, it must be by an examination of these volumes and the comparison of them with the similar productions of the Continent. They can be seen at the British Museum, at Oxford and Cambridge, and in certain private libraries, such as those of the Duke of Northumberland, the Duke of Devonshire, Sir George Holford, and Mr. Dyson Perrins. Mr. Yates Thompson's magnificent collection, which

LINDISFARNE GOSPELS, f. 139.

incorporated the pick of the library of the Earls of Ashburnham, is now for the most part dispersed. Some fine specimens are in the library of Mr. Pierpont Morgan. A few are in continental libraries, but not enough to give any adequate idea of the power of the successive English schools from the seventh to the fifteenth century.

The simple truth is that from about the year 700 to about the year 1400 the primacy in the art of painting, as manifested in the sphere of book decoration, rested always with either France or England, and English art held the supremacy as often as not. England from time to time drew inspiration from other countries, from the East, from France, from southern Germany; but so also did France, and in the one country no less than in the other the foreign elements were absorbed and made portions of a truly national style. The best periods of Flemish and Italian miniature painting came later, in the fifteenth and early sixteenth centuries, when the art was moribund or dead in England, and when the decorations of manuscripts approached more closely the character of easel pictures. For our present purpose they can be left out of account.

Manuscript illumination in Western Europe begins in the seventh century, and it begins, strangely enough, in its extremest corner, Ireland. The Celtic school of art owed something to the Byzantine Empire, which inherited the traditions of Greece and Rome. It owed something also to the Oriental influences, which, as is coming more and more to be realized, spread from Asia through Syria and through Russia to various parts of Europe. But out of these elements the Irish, in the early and great age of their church, evolved an art which was characteristically national. From Ireland, following in the track of Christianity, this art spread into southern Scotland, and thence into northern England, where, modified by the national instinct, but retaining much of its Celtic character, it developed into a school which may properly be described as Anglo-Celtic.

Asia to Ireland.

The finest production of the purely Celtic school is the famous Book of Kells, now in the library of Trinity College, Dublin; the finest of the Anglo-Celtic school is the equally famous Lindisfarne Gospels, in the British Museum. They are typical of their respective styles. Both have the intricate interlaced patterns with which we are familiar on Celtic crosses and metal work. Both (but more notably the Irish) make much use of "Zoomorphic" elements; that is, forms of animals, especially long-legged and long-necked birds, which can be worked into the interlacements in which the artist delighted. The Irish artist used the more brilliant palette. He is fond of bright reds and yellows, which give a rather barbaric splendour to his page. He is more extreme in his fanciful use of animal forms, and is often frankly grotesque. He is full of life and movement. In England the restraint which we shall find to be characteristic throughout of the national taste is at once evident. The colours are more sober. Lilacs and rather pale greens take the place of yellows and bright reds. The technical achievement and the intricacy of patterns are no less; and the finest pages of the Lindisfarne Gospels are unequalled as examples of rich but sober beauty,

resting upon a decorative scheme where intricacy of detail is subordinated to a readily comprehensible pattern. The figure drawing (which is not combined with the decorative patterns, but appears on separate pages containing portraits of the Evangelists) is less original and less successful. It is obviously derived from Byzantine examples, and the artist has failed to master the modelling of the human form. It should be added that gold, which forms so splendid a feature in later illuminations, has hardly as yet made its appearance.

Saxon Artists.

The Lindisfarne Gospels was produced in honour of St. Cuthbert (d. A.D. 687) at the extreme end of the seventh century. The artists concerned in its writing, decoration, and binding bear unmistakable Saxon names, Eadfrith, Ethelwald, and Billfrith. The date and authorship of the Book of Kells are uncertain, but the period is approximately the same. The period was that in which the Irish and Northumbrian churches were the leaders in the civilization of western Europe; when the Irish church produced St. Columba and founded the settlement of Iona, when Northumbria, with its monasteries of Jarrow and Wearmouth, produced Bede, the greatest scholar of his generation, and evangelized the valley of the Rhine, and spread its influence into Germany, Switzerland and even Italy.

But it was in France that its influence was most felt, and it was France that carried on the Anglo-Celtic tradition of artistic and literary culture. When Charlemagne founded his western empire, and organized his kingdom of what we now know as France, he found his subjects sorely deficient in education. He accordingly set himself to revive civilization among them, especially in the departments of Biblical study and of art. For this purpose he had recourse to Northumbria, whence he brought over Alcuin of York to be the master of his schools. Alcuin brought with him both books and scholars. He produced a corrected text of the Latin Bible, which had been much corrupted since the days of Jerome; and under his influence there grew up the new and greatly improved form of script which we know as Carolingian (and which is the ancestor of our modern printed types), and also a new and splendid school of painting, showing evident signs of its Northumbrian origin, which we may designate as Franco-Celtic.

The Northumbrian influence is most conspicuous in a group of sumptuous volumes, sometimes collectively known as the "Golden Gospels," which seems to have been produced in north-eastern France. A fine example is in the British Museum (Harley MS. 2788), but most of them are naturally in France. The scheme of decorated pages and portraits of the Evangelists is the same as in the Lindisfarne Gospels, but the style is changed. Interlacements survive in the details of the decorated pages, and the large ornamental letters are often similar in shape; but the patterns are less elaborate, the figure-drawing (still Byzantine in character) is less stiff, and free use is made of gold,

COTTON MS.

both in the backgrounds and in the writing, which is in gold throughout. New decorative motives are introduced, which seem to be French in origin. In result, the volumes are extremely sumptuous, though the workmanship is less elaborate and perfect in detail.

The style thus developed in France continued, with modifications, under the successors of Charlemagne, and spread also into Germany, though the German work, as usual, is heavier and less spontaneous. In England, towards the end of the tenth century, a new style came into prominence, which owes something to French influence, but developed on original lines. This style is connected especially with Winchester, having its home in the two great monasteries of St. Swithin (afterwards the Cathedral) and New Minster, or Hyde Abbey. From Winchester it spread to Canterbury, and no doubt to other places in the south, but the finest examples are of Winchester origin. The main characteristic of the Winchester style is a framework of broad gold bands, interlaced with rich conventional foliage. Within this framework, but not attached to it, stands the figure of an evangelist or a handsome initial letter, with the first words of the text. As a border for enclosing an illuminated text, this style has seldom been surpassed, and through the eleventh century English illumination was again in the forefront of artistic progress.

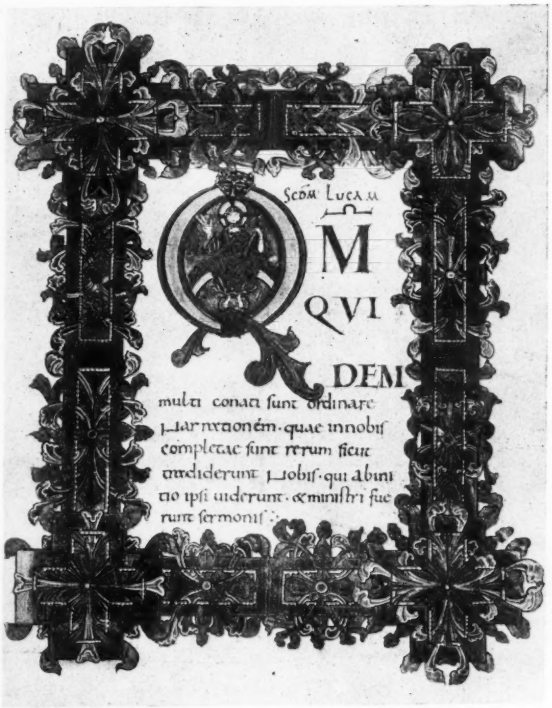
Winchester Styles.

One of the earliest, and in some respects the finest, of the volumes produced in the Winchester style is the famous Benedictional of Aethelwold (963-986), which for the last two centuries has been in the library of the Dukes of Devonshire. Several fine examples are in the British Museum, among them the original charter of foundation of Hyde Abbey in 966, a Psalter written at Winchester, probably in the time of Bishop Aethelwold, notable for the fine initial B, which for a century served as a model for the initial in English Psalters, and a fine Gospels, written at or for the monastery of Christ Church, Canterbury. Another Gospel book, of the eleventh century, is remarkable as having silver instead of gold for the bands which form the main structure of the framework; while in yet another volume (Arundel MS. 60) the bands are in colour. Other good examples of the Winchester style are at Trinity College, Cambridge, Rouen, and Rome; but the total number of them is not large.

Side by side with this highly decorative style, English art followed another line of development, which was to lead to admirable results. This consists of outline drawings, very lightly tinted, and of delicate workmanship. For the origin of this style we must look to north-east France, where (apparently in the neighbourhood of Rheims) was produced in the ninth century the celebrated Utrecht Psalter, which, but for its having been accidentally detached from Sir Robert Cotton's library, would now be in the British Museum. The whole of the text of the Psalms is illustrated by drawings of figures in outline, with elongated limbs, hunched shoulders, and fluttering draperies, the whole conveying an impression of life and motion which is very attractive, though sometimes grotesque. A copy of this Psalter, in which the details are freely modified, though the general composition remains the same, was produced, apparently at Canterbury, early in the eleventh century (now Harley MS. 603 in the British Museum), and the style took a firm hold in England. Sometimes it is seen by itself, as in an illustrated copy of a Latin poem by Prudentius in the

STOWE MS. 944, f. 6.

British Museum, sometimes supplying the figure drawing in connection with borders of the Winchester style. The fluttering draperies, the rounded shoulders, and the general sense of life and motion, remain characteristic of English work in this style. In France, its original home, it does not seem to have taken root, and had no development.



ROYAL MS.

We have now brought the history of English art down to the period of the Norman Conquest; and with this event, which cut across all the activities of the national life, and profoundly affected its art and literature, no less than its political development, it will be convenient to make a pause. That painting was a vigorous art in England during these four centuries, and that English art held a high, and often the leading, place in European painting, will be plain even from this short summary of its history.

HAFNIUM.

THE rare element Hafnium discovered the other day in association with Zirconium minerals, possesses a high power of electron emission when heated. It may possibly find an application in wireless valves.

Books Received

Practical Organic Chemistry. JULIUS B. COHEN, Ph.D., B.Sc., F.R.S. (Macmillan & Co. Ltd. 6*s.* 6*d.* net).

Quantitative Organic Microanalysis. FRITZ PREGL, D.Sc., Ph.D. (J. & A. Churchill. 12*s.* 6*d.* net).

Rejuvenation. NORMAN HAIRE, Ch.M., M.B. (George Allen & Unwin Ltd. 7*s.* 6*d.* net).

Trade Routes and Commerce of the Roman Empire. M. P. CHARLESWORTH, M.A. (Cambridge University Press. 12*s.* 6*d.* net).

Ancient Egypt. March, June, September, 1924. Parts I, II and III. Edited by PROF. SIR FLINDERS PETRIE, F.R.S., F.B.A. (Macmillan & Co. 7*s.* yearly. 2*s.* quarterly).

The Rock Tombs of Meir. Part IV. A. M. BLACKMAN, D.Litt. (Egypt Exploration Society. £2 2*s.*).

Psyche. Vol. V. No. 2. October 1924. (Kegan Paul. 5*s.*).

Chemistry and Atomic Structure. J. D. MAIN SMITH, Ph.D. (B'ham), B.Sc. (Lond.). (Ernest Benn Ltd. 12*s.* 6*d.* net).

Glimpses of Japan and Formosa. HARRY A. FRANCK. (T. Fisher Unwin Ltd. 10*s.* net).

Ido-English Dictionary. L. H. DYER. (Sir Isaac Pitman & Sons Ltd. 10*s.*).

The Purpose of Education. ST. GEORGE LANE FOX. New cheap edition, revised and enlarged. (Cambridge University Press. 4*s.* net).

British Journal of Radiology. Vol. XX. No. 81. October 1924. (Percy Lund, Humphries & Co. Ltd. 5*s.* net).

Australian Journal of Experimental Biology and Medical Science. Vol. I. Part 3. (University of Adelaide. Quarterly. £1 1*s.* per annum).

Bulletin of the Imperial Institute. Vol. XXII. No. 3, 1924. (John Murray. 3*s.* 6*d.* net).

Our Physical World. ELLIOT ROWLAND DOWNING. (University of Chicago Press. Cloth 14*s.* Leather 19*s.* 6*d.* net).

Oriental Forerunners of Byzantine Painting. Vol. I. JAMES HENRY BREASTED. (University of Chicago Press. 22*s.* net).

Geographical Journal. Vol. LXIV. November, 1924. (Royal Geographical Society. 2*s.*).

Telephotography. CYRIL F. LAN DAVIS, F.R.P.S. (G. Routledge & Sons. 3*s.* 6*d.* net).

The Lake Villages of Somerset. ARTHUR BULLEID, L.R.C.P., F.S.A. (Folk Press Ltd. 2*s.* net).

Radioactivity and the Surface History of the Earth. JOHN JOLY, Sc.D., F.R.S. (Oxford University Press. 4*s.* net).

Scientific Research and Human Welfare. FRANKLIN STEWART HARRIS, Ph.D., and NEWBERN I. BUTT, B.S. (Macmillan & Co. 12*s.* net).

The Principles of Comparative Sociology. NICHOLAS PETRESCU, Ph.D. (Watts & Co. 7*s.* 6*d.* net).

Everyday Physics. H. E. HADLEY, B.Sc. (Macmillan & Co. 6*s.* 6*d.*).

Electrical Condition. FRANKLIN COXWORTHY. (J. S. Phillips. 5*s.* net).

Perseus or of Dragons. H. F. SCOTT STOKES, M.A. (Kegan Paul. 2*s.* 6*d.* net).

Fresh-Water Aquaria. REV. GREGORY C. BATEMAN, A.K.C. (The Bazaar, Exchange and Mart. 4*s.* net).

Growth of the Mind. PROF. K. KOFFKA. (Kegan Paul. 15*s.* net).

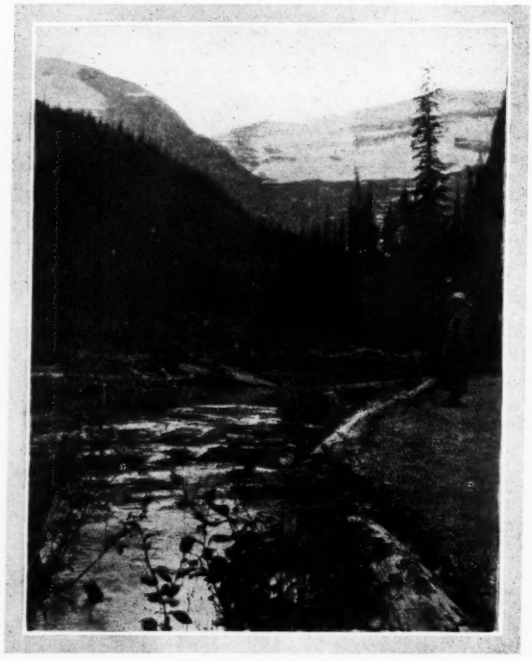
With the British Association in Western Canada.

By O. J. R. Howarth, Secretary to the B.A.A.S.

Thousands of members of the British Association who were unable to go to the recent meeting at Toronto will read with interest and regret this little chronicle of the activities of those members who went on the western excursion to the Rockies.

Of the 570 members who attended the British Association meeting in Toronto last August from Britain, over 300 subsequently took part in the "western excursion" to Victoria (British Columbia) and back. They were accompanied by a few of the Canadians and Americans whose attendance in large numbers at the meeting itself had done so much to ensure its success, and by some of the distinguished European scientific men who had been present at the International Mathematical Congress, which also had taken place in Toronto.

It was a wonderful journey, beautifully arranged with a view to enabling the travellers to use their limited time to the best advantage. It lasted for 17½ days and covered 5,400 miles of railway travel in addition to the sea passages between Vancouver and Victoria. The route nowhere covered the same ground twice, as the journey outward was over the lines of the Canadian National Railway (with a short stage on those of the Timiskaming and Northern Ontario system), and the return over those of the Canadian Pacific. Each of the two great Canadian railway systems, the National and the C.P.R., provided a special train for the entire journey. Each train comprised a baggage-car, a car for the train staff, two dining-cars, eight standard sleeping-cars, and one observation car with sleeping compartments. These trains were the homes of the party practically throughout the excursion, and as homes they came to be regarded. Whatever the shortcomings of a railway-car as a place of residence, they are easily overcome and forgotten in such luxurious trains as were placed at the disposal of the travellers on this occasion. The National Railway even supplied a daily news bulletin during the outward journey, and had a wireless installation on its train by which concerts and other entertainments were picked up from all over the continent: the rather strident tones of the loud speaker were perhaps forgotten in the scientific wonder of the thing; at any rate, it filled the observation car whenever it was in action. Each train was 370 yards long, yet they were only "double-headed" (by two engines each) over the difficult mountain track of the Canadian Pacific line through British Columbia, and here that company added to each train one of their open observation cars, from which the magnificent scenery could be viewed uninterruptedly.

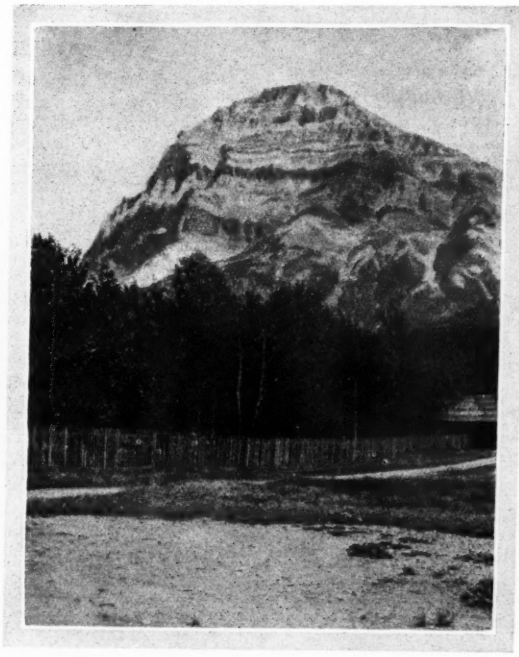


THE VALLEY ABOVE LAKE LOUISE
Typical scenery of the Rocky Mountains.

The majority of the party left Toronto at night on August 17, and woke next day to find themselves in Northern Ontario, where great developments have taken place in recent years, and are continuing, in the direction of gold- and silver-mining, and (on the so-called clay belt) of agriculture. Parties of botanists and geologists, who had left Toronto earlier for a few days' field-work in this region, joined the main body, and the mining centres of Cobalt, Kirkland Lake, and Timmins were visited, as also was the remarkable industrial centre of Iroquois Falls. Here is a great paper-mill, using power from the falls and wood (for pulp) from the vast forest-tract in which it is buried, linked only by a few hundred miles of railway with the centres whose "newsprint" it supplies, and from which the community of the mill, inhabiting a

garden-city in the wilderness, receives its necessities. At the mining-centres competent guides took each a few members around the works, explaining the processes of crushing and extraction; in some instances it was possible to go underground and see the winning of the ore.

The trains now passed on to Winnipeg, Manitoba, where members who had been present at the Association meeting there in 1909 admired the development of the city during the past fifteen years. The party was entertained in a new parliament building, and an agricultural college, which are architecturally beyond praise: it was gathered that these had saddled the province with a debt it cannot easily afford, but posterity may call their designers blessed. There can scarcely be in the world finer examples of the advancement of contemporary architecture than those which were seen by the Association party in Canada, beginning with Hart House and the lovely Soldiers' Tower in the University of Toronto, and continuing here in Winnipeg, and in the university and other public buildings of Saskatoon, Edmonton, and other centres in the west



MOUNT STEPHEN, ROCKY MOUNTAINS.

Ceremonies.

Saskatoon, Saskatchewan, was the next stopping point. Here the principal ceremony was the opening of a new chemical building in the University of Saskatchewan, after which sessions of the sections of chemistry, geology, zoology and agriculture were held. There were also sessions of the physical, geological, botanical and agricultural sections at Edmonton in the University of Alberta, but to other scientific occupations of the party we may return after tracing the journey to its end.

From Edmonton, the trains entered the glorious mountain-country of the far west, and the party stopped at the National Railway's hotel in Jasper National Park. The weather was not too kind here, and it was still less favourable later in the day, when Mount Robson was concealed in cloud down to the foot of the lowest glacier. But on leaving the trains next day at Vancouver, members saw the Pacific coast under perfect conditions, which continued from now until they left the mountains, eastbound, five days later. The sea-passage through the islands from Vancouver to Victoria, the trip taken by some of the members up the noble fiord of Howe Sound, and the visits to Stanley Park, the Capilano Canyon, and other points of interest near Vancouver, were thus enjoyed to the full, and those who, from Vancouver Island or Burrard Inlet, in a clear evening light, saw Mount Baker 90 miles away (and believed that they saw Mount Rainier, still farther) will not forget the sight.

Dry Belt.

The journey eastbound through the mountains was planned so that the scenery should be admired to the full; there was hardly any night-running. The canyons of the Fraser River, the "dry belt" of British Columbia (at its driest), the beauties of Glacier, Lake Louise, and Banff where the longest halts were made, were well seen. The weather broke as the party left the mountains, and driving wind, with rain or dust-storms gave the travellers an idea of the less favourable aspects of life on the western prairies, and somewhat detracted from the pleasure of receptions at Calgary and Regina. The small party which paid a private visit to the ranch of H.R.H. the Prince of Wales near High River, Alta., had fortunately returned from it before the storm. The weather mended when Kenora, Ont., was reached, and a day's sailing on the Lake of the Woods was enjoyed. Fort William and Port Arthur, the grain-exporting harbours at the head of Lake Superior, were next visited, and during the ensuing run along the north coast of the lake short halts were made to afford views of this shore, rocky, cliff-bound, and forested, and though traversed by a main railway, untouched either by industrial development or by the inroads of holiday resorts. The last call was at Sudbury, Ont., for a view of the famous nickel mines, and Toronto was reached in the morning after that visit.

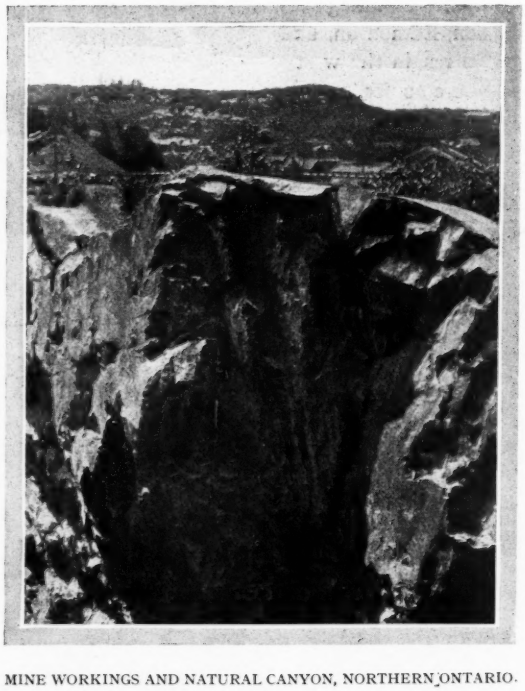
SIR DAVID BRUCE (President) AND LADY BRUCE (on left)
AND OTHER MEMBERS OF THE PARTY AT RED LAKE, ONTARIO.

Such is an outline of the itinerary, and a few of its chief points of interest have been indicated; but the excursion was by no means purely a "joy-ride." Representatives of every section of the Association, as well as of the Mathematical Congress, took part, and it may be said that the journey held scientific interest for every one of them, and offered occasion for real scientific work for many. In this respect the visitors gave as well as received. Most of the larger cities visited had asked for speeches or lectures from representative men and women of science, and they got them. Reference has been made to the sectional sessions at Saskatoon and Edmonton: in addition, lectures were given, or speeches of scientific interest delivered, at both those places and at Winnipeg, Vancouver, Victoria, and Regina. The occasions for them were either the public luncheons or dinners at which the party was generously entertained, or meetings in universities or with local associations or clubs, and they covered a variety of subjects from physics to economics and public health.

Local Interest.

The interest of the local listeners in science, and particularly in its applications to their own most conspicuous problems, was manifest; and, on the other hand, every opportunity was seized of acquainting the visitors with those problems and of showing how they are being dealt with, as well as of affording them an insight into the scientific interests of the country itself.

In this respect it was perhaps the field-workers who scored most heavily—geologists, botanists, agriculturists, and zoologists. For these in particular numerous "side-trips" were arranged, but it was not uncommon to see workers in other departments taking on new scientific complexions in order to participate in these. A geological party, as has been said, preceded the main party from Toronto in order to make fuller study of the mineral-bearing region of Northern Ontario; a botanical party did the same, spending a few days in the forest region of Lake Temogami. The geologists, again, had special excursions from Winnipeg to Stony Mountain, in the vicinity of Edmonton and Vancouver (where, among other points, the Britannia Copper Mines above Howe Sound were seen), to Mount Stephen in the Rocky Mountains, to old gold workings on the Lake of the Woods, to Mount McKay behind Fort William where the ancient beach-levels of the former Lake Algonquin were finely seen, at Coldwell on the north shore of Lake Superior, and at Sudbury. The botanists (and no less the entomologists) had their opportunity at every daylight stoppage of their train, when, at a moment's notice, they would leap from the cars to collect vigorously alongside the track; the botanists' car after such escapades was irreverently likened to a hayfield, but the chances afforded in this way were genuine and valuable. A party of botanists left the main body at Edmonton for a long motor journey through Central Alberta and thence westward, when they enjoyed special opportunities of investigating the flora of the prairies, the foothills, and the mountains; they rejoined the trains at Banff on the eastward journey. Those who did not take this trip had opportunities for botanical study, under local guidance,



MINE WORKINGS AND NATURAL CANYON, NORTHERN ONTARIO.

in the neighbourhood of Vancouver and Victoria. The principal zoological excursion was that arranged for marine biologists to the famous station at Nanaimo on the Pacific coast. The agriculturists were taken to view, in detail, a bit of the clay-belt country in Northern Ontario, and experimental stations at Winnipeg, Saskatoon, and elsewhere, and obtained a very clear general idea of farming operations under the different conditions of the regions traversed.

Engineering.

For the rest, engineering members of the party found special matters of interest in the power plants at Iroquois Falls, Point du Bois (the source of power for the Winnipeg hydro-electric service, 76 miles from the city), and Lake Buntzen, near Vancouver. For the economists, the whole journey afforded obvious opportunities; but there were points of special interest, such as the grain exchange at Winnipeg. Anthropologists visited a settlement of Squamish Indians near Vancouver, and they and all the other members who were interested in overseas settlement had chances to see something of life in Canada under the various conditions of the eastern mining centres, the prairie settlements, the far west, and the great cities. And no member, whatever his or her scientific work might be, could fail to be impressed by the provision made for the education of the people, whether in the universities already referred to, or in the fine schools which are maintained under the wide-spreading educational systems of the various provinces.

There can be few, if any, exact parallels to these British Association journeys overseas (of which the last before this year was that to Australia in 1914). Most empire tours, or visits from the dominions to this country, are made by parties whose members share one common interest in some particular aspect of commerce or administration. The common interest of a British Association party—science, and the advancement of science—is obviously wider than any of these; and it is good to find the advancement of science recognized as an object so desirable that a great dominion, its provinces and its citizens, are ready to spend so much, and to extend their hospitality so generously, as Canada and Canadians did to ensure the success of the journey described, and the Toronto Meeting which preceded it. On this side, it cannot be doubted that members who took part in the excursion will speak of and teach freely what they saw; there are permanent records of their travels in the specimens collected and the photographs which must have been taken in prodigious quantity, in addition to the cinema film made by official operators from the Ontario Government; all these things will broaden knowledge of the dominion in this country (where there is room for broadening), and this process will serve one of the main objects of the meeting and the excursion.

BIOLOGICAL NOVELTIES.

THE scientific investigation of an effect and a short paper read before a learned society do not always mean that an immediate commercial application of the results is likely or desirable. Nevertheless, certain biological investigations in France by M. M. P. Carnot and E. Terris are of interest.

They have made certain researches and experiments which show that injections prepared from the muscle of lean animals produce no thinning effect on the animal with surplus fat. Injections of the liver and, in particular, the pancreas, lung and gastric elements of lean animals into others produced a rapid loss of weight. The tests were carried out on dogs and rabbits.

These researches may be the first steps in finding a new nostrum for that terror of middle-aged women, excess weight. If a new treatment is evolved which will avoid the present regime of exercise and the renunciation of sweets and starch, it will be certain of popularity if not of success.

The nursery that rejects cod-liver oil and its admirable vitamins and declines to be deceived by even the sweetest of malted mixtures or flavoury emulsions can still be defeated by the scientist. Cows are now fed on cod-liver oil which passes into the butter and not only incorporates the valuable soluble vitamin A but incorporates other anti-rachitic elements derived from the cow. Experiments with cod-liver oil butter and rickety children show extremely successful results, and further experiments are being proceeded with in the attempt to produce a butter rich in every necessary form of vitamin useful to growing babes.

INSULIN.

INSULIN is now being obtained from the islet tissue of the codfish instead of from the pancreas of animals killed for butcher's meat. The fish tissues contain weight for weight some ten times as much insulin as the animal tissues and the new source of supply may prove to be extremely important.

The process as described by Dr. H. W. Dudley in the *Biochemical Journal* consists in picking out the islet tissue, which lies near the gall bladder and is easily found when the fish are gutted, and dropping it into dilute picric acid solution. This fixes the tissue and converts the insulin content into a picrate which is extracted with watery acetone after the material has been ground in a mortar with sand. A final process converts the picrate to the hydro-chloride.

The Vitamin Experiments on Chickens.

By J. Riley, B.Sc.

A new scientific diet for chickens has produced some astonishing results. This article will be read with interest not only by biologists, but by all who keep poultry. If you apply the system yourself you will bless DISCOVERY *at the breakfast table.*

MOST of us can remember the time when science looked upon food in a relatively simple and rough-and-ready way. In those days, food was regarded as consisting of five essential constituents—fats, proteins, carbo-hydrates, mineral salts and water. Of these, the first three were considered to be of chief importance. The needs of the body were regarded in a similarly simple way. As the bio-chemist would express it, the main attention was given to the "energy requirements" of the body, which was regarded as needing material for heat, energy and growth. The simple point of view was that fats produced heat; proteins made for growth; while carbo-hydrates—resolved by digestion into a simple kind of sugar—were the chief sources of energy. The class of mineral salts was at that time a somewhat doubtful "extra" which included the food constituents which were required in small quantities for special purposes. Thus it is familiarly known that iron is required for the manufacture of the haemoglobin of the red corpuscles of the blood. Also lime is utilized in the making of bone, and is thus an essential constituent of food during the period of growth.

Food Complexities.

It is only within the last fifteen years that the analysis of food has appreciably advanced beyond the simple ideas to which we have just referred. Researches during this period have shown that a satisfactory dietary must include other materials which are equally as important as fats, proteins, carbo-hydrates or mineral salts. Even in regard to these, investigations are still proceeding. We know now, for instance, that different proteins are very different in their food values. It is generally agreed that vegetable proteins are poor in quality as compared with animal proteins. The proteins of green leaves may be an exception to this rough conclusion, but very little is known about them at present.

The chief advance in our knowledge of food has undoubtedly been the revelation of the existence of three important "accessory food factors," or "vitamins," which need to be present in any dietary in order to make it satisfactory and health-supporting. In discussing this point, the Report of the Medical Research Council on "The present state of knowledge of Accessory Food Factors (Vitamins)" (H.M. Stationery Office. 4*s.* 6*d.* net) states that "much that is misleading and inaccurate has undoubtedly followed from the attempt to allocate to every foodstuff a nutritive value estimated solely in terms of digestible protein, fat, carbohydrate, and salts." Experiment is the sole means by which we can test our ideas and opinions, and experiments upon animals have shown conclusively that a dietary composed exclusively of pure fats, proteins, carbo-hydrates and salts (even if these are in the correct proportions) is incapable of promoting growth and health.

Professor Plimmer's Experiments.

Some of the most striking experiments that have recently been performed in the study of the vitamin requirements of a satisfactory dietary, are those which have been conducted in connexion with the rearing of chickens by Professor Plimmer and Dr. J. L. Rosedale (Beit Memorial Research Fellow) in the Chemical Department of St. Thomas's Hospital Medical School. These experiments show in an extraordinary and striking fashion how tremendous is the influence of the vitamins in making a dietary satisfactory. Although their amount is so small, yet without them a dietary is incapable of promoting growth or, in extreme cases, even of supporting life. They are absolutely essential nutritional elements. Most people nowadays accept this conclusion up to a certain point, but it is doubtful whether anyone realized how potent the vitamin factor actually is, until experiments of the type of Professor Plimmer's brought out the truth of the matter in so unmistakable and surprising a fashion.

The Vitamins.

In order to make quite clear the meaning of the experiments that we are about to describe, it will be useful to give a brief statement concerning the three vitamins, the effects of which were observed. These are usually called Vitamin A, Vitamin B and Vitamin C. The absence of these from a dietary leads in the case of a human being to the so-called "food deficiency" diseases.

Vitamin A (sometimes called the fat soluble factor) was first detected in butter and egg yolk. Subsequent investigation has shown that cod-liver oil is one of the richest sources. Lack of this vitamin in man leads to rickets and a lowered resistance to tubercle and other infections.

Vitamin B (also called the water soluble factor, and the anti-neuritic vitamin) occurs in the embryo or germ of the cereals, and also to a lesser extent in the bran, or enclosing envelope, of the grain. When these portions are removed by milling, however (as takes place in the preparation of white wheaten flour or polished rice), the product is lacking in this vitamin, and if it is relied upon too exclusively as a diet, it leads to the disease known as beri-beri. This is a disease, characterised by serious nervous disorder, which occurs mainly among rice-eating populations. Its consequences are serious. In the case of birds, the corresponding disease is known as polyneuritis, which we shall have occasion to mention again later. The value of experiments on birds is shown by the fact that it was the discovery of polyneuritis among the poultry at a prison in Java in 1897 that led to the elucidation of the human disease of beri-beri from which many of the inmates were suffering.

Vitamin C is sometimes known as the anti-scorbutic vitamin, and its deficiency in a diet leads to the well-known disease of scurvy. This vitamin is chiefly supplied by fresh fruits and vegetables.

It must be remembered, of course, that the vitamin requirements of animals are not quite the same as those of man. For instance, the guinea pig is especially liable to scurvy if the C-vitamin is absent from its dietary. Professor Plimmer's experiments with birds, however, show that the absence of C-vitamin from their food has little if any effect.

An Artificial Diet.

The first requirement for the experiments was an artificial diet, which would permit the amount of each of the vitamins to be varied at will. To ensure this, it is desirable that the basis of the dietary shall be as free from vitamin as possible. White rice and white flour fulfil this requirement in the case of carbo-hydrates, whilst suitable proteins are egg white and white fish flesh. Professor Plimmer also notes that most dried foods have no C-vitamin, so this vitamin can be avoided in the foods selected, if they are given in the dried state.

It is thus possible to obtain the main constituents of the dietary free from vitamins. To this basis, the vitamins can then be added, as desired, in measured quantities of very concentrated extracts. The extracts used for this purpose were cod-liver oil for Vitamin A; yeast extract (or marmite) for Vitamin B; and lemon or orange juice for Vitamin C.

The Stage of Trial.

The first experiments were designed to find out whether it was possible to arrive at an artificial diet of the kind we have described, upon which chickens could actually be reared to maturity in the close confinement of a laboratory. Unfortunately, there was little previous experience to go upon, except in regard to the staple constituents of the dietary. The vitamin requirements were an absolutely unknown quantity, and all that could be done was to adopt the method of trial and error, in the hope that by repeated trial a successful combination of the three vitamins could be hit upon. Unfortunately, it is not easy to vary three items at once with any guarantee of success.

The basal diet consisted of oatmeal together with a small quantity of milk. The quantity was at first 120 grams of oatmeal to 200-250 c.c. of milk. To this was added 5 c.c. of cod-liver oil to supply Vitamin A; 0.5 grams of marmite for Vitamin B, and 30 c.c. of lemon juice for Vitamin C. Any additional food was given as oatmeal.

Twelve white and twelve black Leghorns were used for the experiment. These were about three days old when they arrived. Although they were very weak and not expected to live, they all recovered except one upon the diet given, and no signs of illness were noticed up to the end of the first twenty-eight days.

It was then decided to vary the diet in order to observe effects. The first vitamin to be studied was Vitamin C. This was chosen because of the importance which poultry-keepers commonly attach to plenty of green food, one of the uses of which might be the supply of this vitamin. To begin with, the quantities of all the vitamins were halved. The effect was almost immediate. Within five days the birds became less active and began to droop. This was thought to be due to lack of vitamin C, and, consequently, the amount of lemon juice was first doubled and then increased to three times the reduced amount. In spite of this, no difference was observed in the condition of the birds. Clearly the trouble was not due to lack of the anti-scorbutic factor.

Attention was next given to Vitamin B, which was also doubled and brought up to its original proportion, but still without effect, some of the birds being by this time so ill that they had to be separated. Apparently the only remaining step to take was to

try the effects of extra cod-liver oil. This was, therefore, increased, but there was still no difference, and one bird died.

Avian Beri-Beri.

By this time the symptoms had become more pronounced. There were distinct signs of leg weakness, the wings drooped and the feathers were ruffled. These were recognized to be the early signs of polyneuritis, or avian beri-beri, to which we have already referred. The cause of the illness was, therefore, at last clearly indicated. It was accounted for by insufficient Vitamin B.

There is a curious point in connexion with this conclusion that demands a careful explanation. As a matter of fact, the amount of Vitamin B which the birds were actually receiving at this time was sufficient, but only just sufficient, for their *current* requirements. It was not enough, however, to make up for the deficiency which had been caused by the halving of the amount of Vitamin B during the period when the effects of Vitamin C were being studied. It was this accumulated deficiency that gave rise to polyneuritis, and that needed to be made good by additional Vitamin B.

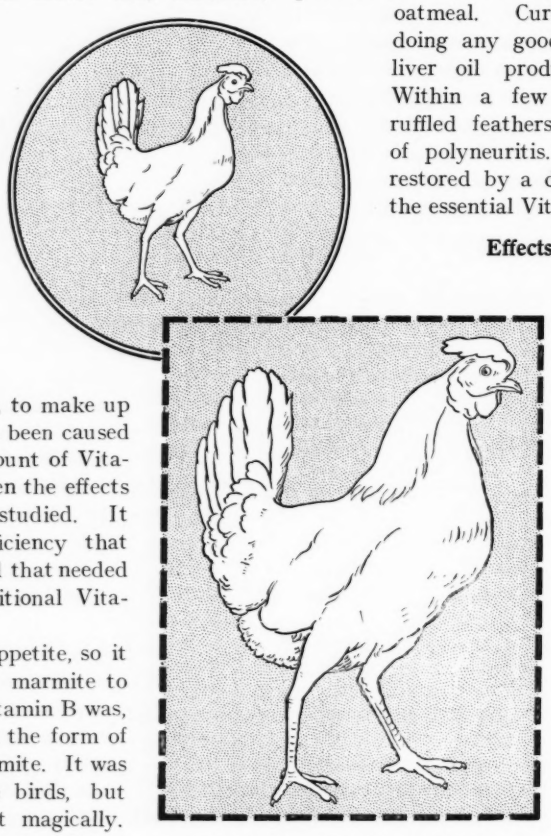


DIAGRAM SHOWING THE PROPORTIONATE SIZE OF CHICKS AT FOUR MONTHS.
The upper figure represents the ordinary, the lower the vitamin-fed, bird.

The birds had lost their appetite, so it was too late to add extra marmite to their food. The necessary Vitamin B was, therefore, given to them in the form of a two per cent. drink of marmite. It was not only palatable to the birds, but seems to have acted almost magically. They recovered within three days. Other birds which fell sick also got better after a similar marmite drink.

After this treatment, the birds had all recovered, being back on their original diet, except for a slightly greater amount of lemon juice. There was little point, in an experimental investigation, in merely continuing a diet which seemed to be satisfactory and no more. It was clear that the diet as it stood would not lead to any ill effects. But this was not enough. The question now was, whether any possible alteration in the diet would lead to improvement in the growth and condition of the birds. The next thing to try, therefore, was the effect of the increase of the amounts of the various vitamins beyond the quantities which seemed to be barely sufficient for the bird's requirements.

Earlier in the experiment the birds had been divided into two groups, so as to double the experimental possibilities. The first change made in the diet was to double the quantity of cod-liver oil supplied to one of the groups. This was increased to the proportion of 10 c.c. of cod-liver oil to 120 grams of oatmeal. Curiously enough, instead of doing any good, the increase in the cod-liver oil produced the old symptoms. Within a few days, drooping wings and ruffled feathers proclaimed the early signs of polyneuritis. As before, health was restored by a drink of marmite containing the essential Vitamin B.

Effects of Cod-Liver Oil.

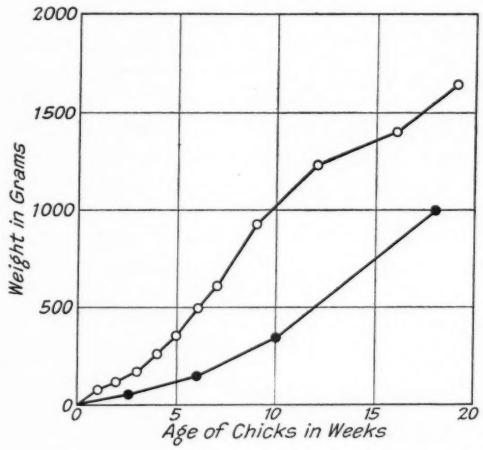
The experiment was then repeated with the second group of birds, the cod-liver oil being increased from the normal 5 c.c. to 12.5 c.c. per 120 grams of oatmeal, the first group being put back on the smaller quantity. The birds with the extra cod-liver oil again showed signs of sickness, but they recovered when the quantity of marmite in their daily food was doubled.

The explanation given of this curious occurrence is that the trouble was caused by the extra fat in the cod-liver oil. This evidently needs additional Vitamin B in order that it may be properly assimilated. In order to test this point, the two groups were kept on the same oatmeal diet, with equal amounts of lemon juice for Vitamin C. One group had 5 c.c. of cod-liver oil and 3 grams of marmite per 180 grams of oatmeal. The other group had 12.5 c.c. of cod-liver oil, but 5 grams of marmite, the additional 2 grams of marmite being given in an attempt to provide for the extra requirements due to the high proportion of cod-liver oil in the diet.

On these diets, both groups of birds were kept in perfect health until the experiment had to be terminated, at the end of five months. By that time the birds were mature, and the hens began to lay a month later. The experiment pointed out the prime importance of Vitamin B in connexion with the rearing of chickens. The other two vitamins are required to a much smaller extent.

Success of an Ideal Diet.

After this preliminary and tentative inquiry, Professor Plimmer was ready to test the results of his experiment upon a fresh group of birds. In this case, no time had to be wasted in searching for a satisfactory diet, and there were consequently no setbacks. In the first experiment, 21 out of the 24 chicks were reared to maturity, so from a casual point of view the attempt was successful. Its results may, however, fairly be regarded as typical of what may be achieved by a casual diet that is arrived at



The black line shows ordinary feeding, the upper line the steady increase resulting from the ideal diet of good protein with the right proportion of vitamins.

by means of a method of trial and error, that takes note of every unsatisfactory result, and makes change after change until a diet is discovered that is just good enough to bring the chickens to maturity.

In Professor Plimmer's second experiment, there was little trial or error. He had scientific experience to go upon, and the results can only be described as extraordinary. Oatmeal was again used as the cereal, but instead of milk, the composition of which varies considerably, dry preparations of casein and secwa (or dried whey) were used as a source of protein.

We have already stated that proteins vary greatly in their value, which is measured by their power to promote growth. Cereal proteins are not regarded as being of first quality. Casein and secwa, however, are both thoroughly good proteins, the value of which seems to be due to the fact that they contain a high amount of the amino acid, lysine, which earlier experimenters had shown to be a valuable growth factor in proteins used for rearing chicks. In previous experiments, however, the mortality of the chicks had been very considerable, which was most probably accounted for by an insufficient supply of vitamins. Professor Plimmer, therefore, wished to find out what effect would be produced by a combination of " good " protein with the proper amount of the three vitamins.

Experimental Results.

At the commencement of the experiment the proportions of the food constituents were 30 grams of oatmeal to 15 grams each of casein and secwa. As time went on, the amounts of casein and secwa were gradually cut down, to reduce the cost of feeding, being replaced by a corresponding amount of oatmeal. At first 2.5 c.c. of cod-liver oil and 15 c.c. of lemon juice were given per day. As the chickens grew, these quantities were increased to 5, then 7.5 and 30, then 45 c.c. per day, at which figures they were kept constant for the remainder of the experiment. At no time, therefore, was cod-liver oil given in excess. The amount of marmite was 0.25 grams per 30 grams of oatmeal, this being the amount that the previous experiment had shown to be sufficient, provided that the cod-liver oil was kept within proper limits.

The results were astonishing. Nine-day-old white Leghorns were used for the experiment, and they all grew very rapidly. The result of feeding scientifically can be clearly realized by comparing the birds in this experiment with those in the first experiment which we have just described. The birds in the second experiment were as heavy at the end of three weeks as the previous birds had been at the age of six weeks. The cocks began to crow at the end of 49 days, instead of during the third month. The sexes were mature in just over three months instead of five. The hens began to lay at the age of 139 days (four months and a half) instead of this being delayed until the end of six months These results point clearly to the desirability of a combination of good protein, and the proper proportion of the essential vitamins, if maximum growth and development are to be ensured. The rapid growth and excellent condition of chickens fed on this diet have been confirmed by later poultry farm experiments.

Later Experiments.

Later experiments were concerned in the main with making still closer inquiries into the interesting facts brought out in these two experiments. Thus the possibility was investigated of replacing casein and secwa by dried skim milk, and using white rice instead of oatmeal. At the same time the yeast extract, cerema, was used instead of marmite as a source of Vitamin B. Ten chicks out of twelve died as a result of this experiment. In order to save the other two, it was necessary to increase the amount of cerema very considerably. The result was taken to show that more Vitamin B is needed to balance rice than oatmeal. This is to say, oatmeal itself contains a considerable amount of Vitamin B.

Arising out of this experiment it was desired to arrive at accurate information in regard to the absolute requirements of chicks for Vitamin B. Unfortunately, it is not possible at present to obtain the vitamin itself in a pure form. The vitamin requirement was, therefore, measured in terms of marmite, which is not only rich in Vitamin B, but which also contains it in a very constant proportion. The chicks were fed on rice and fish meal, which are without Vitamin B, and it was found that Vitamin B, in the form of marmite, was required to the extent of 8.6 per cent. of the food. On the other hand, with oatmeal as the food, only 1.6 per cent. of marmite was needed. This is, of course, because oatmeal itself contains a large amount of the vitamin. In fact, measured in the way this experiment suggests, oatmeal may be said to have the equivalent of 7 per cent. of Vitamin B, measured as marmite. And if birds need 8.6 per cent. of marmite, then oatmeal may be said to be short of 1.6 per cent.

Taking marmite as the most convenient standard, Professor Plimmer went on to measure the comparative values of various foodstuffs for Vitamin B. Taking the vitamin value of marmite as 100, the figures for the chief foods investigated are given in the following interesting table :—

Marmite	100	Egg Yolk	33	Lentils	33
Wheat Germ	67	Ox Liver	33	Peas	20
Pressed Yeast	40	Ox Brain	17	Barley (unhusked)	27
		Sheep Brain	8	Barley (husked)	20
		Ox Heart Muscle	20		
		Beef Muscle	5		

Food as a Source of Pigment.

In conclusion, we may refer to a very curious result that was obtained almost as a by-product in connexion with the numerous experiments that Professor Plimmer conducted. It was shown by two observers, Palmer and Kempster, in 1919, that the yellow colouring matter of the legs, beaks and egg yolks of birds is obtained from the yellow pigment which is present in the plants and vegetable matter which they eat—especially in yellow maize and various green foods.

Professor Plimmer was, therefore, interested to observe what the effect was of feeding chickens on foods from which this colouring matter is absent. As might perhaps be expected, the result of feeding chickens on white maize and other foods which contain little yellow pigment, was that the birds had white instead of yellow beaks and legs, while their eggs had very little colour in their yolks. In the cases of the birds in the experiments which we have described, the yolks were of a pale yellow colour, the pigment being derived from the oatmeal in the food.

In later experiments, chickens were fed on white rice and dried skim milk, neither of which has any trace of colouring matter at all. The egg yolks of these birds were totally free from colour. In a hard boiled egg it was difficult to distinguish by appearance between the yolk and the white. At the same time, the chemical composition of the yolk was quite normal and the taste was similar to that of an ordinary yellow yolk.

The chicks hatched from these eggs were also white, except for small particles of a dark sort of yellow over the back. It thus appears that the yellow colour of the day-old chick is the yellow of the egg yolk, while this in turn comes from the yellow food of the hen which lays the egg. The whiteness of the chick's feathers was, however, only a passing phase. It disappeared as the chicks grew, and they assumed the ordinary colour of the feathering of their strain. A full account of Professor Plimmer's experiments is given in the *Biochemical Journal* for 1922 and 1923.

NEW CURE CLAIMED FOR GOITRE.

IODIZED SALT is the name given by the Canadian Salt Co. Ltd. of Windsor, Ontario, to their latest product which they claim is a perfect preventive against goitre. The Ontario Department of Health has sanctioned its use and the medical authorities predict that its use will greatly check the prevalence of goitre. Although we have not yet learnt the composition of the "Iodized Salt," it is interesting to remember that the ancient Greeks were firm believers in the efficacy of calcined seaweed in combating this disease. Seaweed contains a very high percentage of iodine and this, with the salt that would have inevitably been included in the ashes, may very possibly have given the Greeks a preparation very similar to the Canadian product of which so much is predicted

The Sumerians and India.

By C. J. Gadd.

One of the most sensational of recent archaeological developments is the discovery, in India, of material hitherto associated with Babylonian civilizations of 3000 B.C. *The evidence of recent finds is singularly striking, and is bound to awake much speculation. The interpretation must, however, be left until further excavation affords confirmation of the theory.*

A FEW weeks ago there appeared in the *Illustrated London News* a number of photographs representing objects recently discovered by excavation at two sites, Harappa and Mohenjo Daro, in the Indus valley. It was at once clear to the discoverers that these finds offered something hitherto unknown to Indian archaeology, and something which the actual stratification of the sites showed to be very much earlier in date than the usual antiquities of the country. A few forms of decoration upon painted pottery even suggested a tentative comparison with "Mycenaean" ornament. But it was soon observed that the pottery was perhaps the least significant of the finds for purposes of comparison. Most remarkable of all were certain stamp-seals (one or two specimens of which had previously appeared), with intaglio devices, all representing bulls standing before an uncertain object, and, above all, with a line of unmistakable writing along the top, over the back of the bull. No such script had ever been found in India elsewhere, nor has it any connexion with any of the known varieties of native writing, ancient or modern. But to one of the earliest scripts of the world, hitherto found only in a very different region, it has a resemblance so striking that it can hardly be accidental.

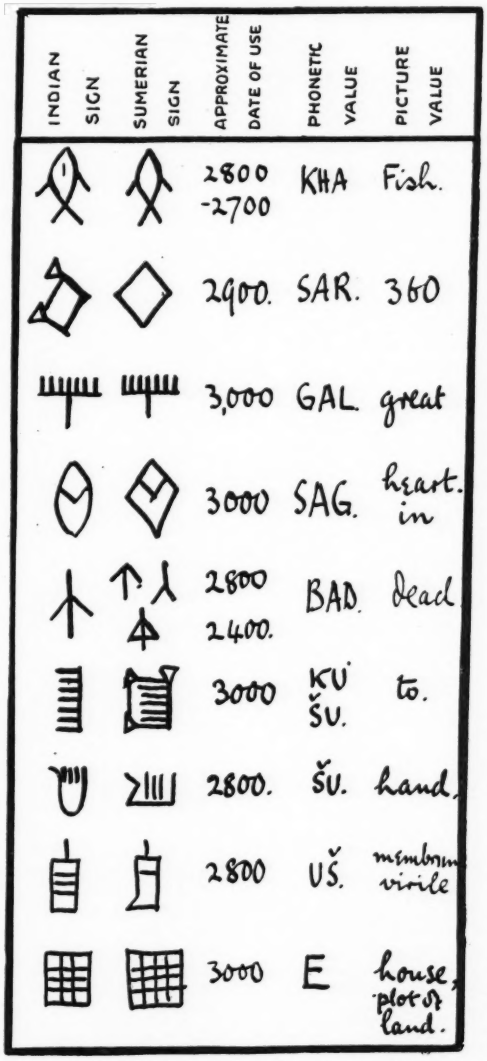


FIG. 1.—Evidence of early intercourse (hitherto unknown) between the two civilizations. Indian and Sumerian signs, which closely resemble each other, compared in parallel columns.
[*By kind permission of* The Illustrated London News.

When the culture of the Sumerians first appears in Babylonia it is already mature in many respects. In particular, at a time which must be well before 3000 B.C., the writing is already in use, and that in a form which betrays considerable progress beyond its first invention. For, while there is no doubt that the Sumerian, like all other scripts, began as pictures, even at this earliest period in Babylonia the original pictures have been so simplified and stylized by use that many are already past recognition. The same applies with singular accuracy to the writing on the Indian seals, but the similarity by no means ends there. Even from the few specimens which are as yet available, it is possible to draw up, without any fanciful comparisons, a list of nine Indian characters which can be almost exactly matched from the Sumerian syllabary of about 3000 B.C., and seven more which have a striking, though less complete, resemblance. And these sixteen account for all but a few of the total number of signs existing on the seals. The likeness cannot be accidental, short of a coincidence barely conceivable; one who is familiar with archaic

Sumerian can almost read off the Indian signs at sight—not, of course, the sense of the inscriptions, but at least the (Sumerian) phonetic values of the characters. The fish, the heart, the right hand with outward-bent thumb, the signs which represent "great," "house," and "scorpion" are all present in India as in Babylonia, and all are drawn in the same conventional manner. Moreover, the Sumerians, with their sexagesimal system of numbers, represented 3,600 (*i.e.*, 60^2) by the complete circle, which was soon modified into an equilateral lozenge-shaped figure, and this also duly appears on the Harappa seals, which indeed seem actually to display numbers written precisely in accordance with the highly characteristic Sumerian method, for one of them bears among other signs a group 𒐐𒌋𒐐 parallel in all respects with 𒐐𒐐𒌋𒐐𒐐 which is, in Sumerian counting, $60\times3+10+2=192$. Similarity could hardly go further. In view of all this, it is perhaps not overbold to see in the inscriptions on the Indian seals in some cases personal names, in others a record of quantities of various commodities. For, on the one hand, the names of owners soon begin to find a place on the engraved cylinder seals from Babylonia, and, on the other, the most archaic Sumerian inscriptions are invariably just such accounts as we have conjectured for the Indian seals. If we may assume that the chief use of these seals was to impress upon the clay lumps securing the ends of a bond passed around a bundle or bale, we shall see an equal suitability in both of these kinds of inscription; and such, in fact, was the chief use of the early Sumerian seals. But the writing is not the only feature in which comparison lies so near to hand. Just such square stamps as those from India are found at Susa and on early Babylonian sites in the period from about 3500 B.C. onwards, for, although the cylinder type existed alongside the stamp and almost completely ousted it in the following centuries, yet the latter was never quite obliterated, and, in the new Babylonian and Persian periods. it returned decisively to popular favour and was never again challenged by the unhandy cylinder.

Bull Symbol.

The bull himself, depicted on all the Indian seals, is hardly less Sumerian-looking than the writing, as appears immediately he is set beside any of the early representations of the animal from Elam or upon cylinder-seals and inlay-panels such as were recently discovered at Tell el Obeid. In all cases, moreover, he stands before an uncertain (cult?) object, the upper part of which sometimes resembles a sheaf of corn, itself represented in the Sumerian syllabary by the sign with the phonetic value *zag*, and it is tempting, though possibly fanciful, to see in the lower cup shaped part of the object something similar to the Babylonian *lilissu*, or ritual drum, which had much the same form, and was covered, on a solemn occasion, with the skin of a bull slaughtered for that special purpose with elaborate observances.

If these remarkable seals stood alone it might still be possible to treat them as a coincidence. But each class of objects from Harappa and Mohenjo-Daro affirms with surprising consistency the same affinities. A haematite weight, which could be paralleled both in shape and material by a hundred from Babylonia, is found among them. So are a number of "ring stones," some of great size and weight; these are surely nothing but complete or broken mace-heads, like those which are so characteristic of early Babylonia, where they are often inscribed with dedications by a king or an official who had presented them to a god in some temple precinct such as the places in India appear to have been; for it is entirely in accordance with early religious practice that the Buddhist sanctuary should occupy the holy place of an earlier cult. Other kinds of antiquities need only be mentioned for the same parallelism to appear immediately: clay figurines, one with a curious horned head-dress ending in scrolls which are character-

With head-dress like the Babylonian symbol adjoining an Indian terra-cotta figurine from Harappa.

Like the Harappa figurine, a symbol of a Babylonian goddess.

FIG. 2.

[*By kind permission of the* Illustrated London News.

To be compared with the Indian pictographic bulls below. Impressions of two cylinder seals in the Louvre, showing Sumerian representations of bulls, about 3000 B.C.

With bulls' necks, as in the Indian pictographs. A Babylonian seal, about 2000 B.C.

Inlay of a bull, from Tell - el - Obeid, 3300 B.C.

For comparison with the Sumerian representations of bulls shown in the photographs above. Prehistoric Indian seals from Harappa and Mohenjo-Daro, with figures of bulls similarly marked, and symbols resembling the Sumerian script.

FIG. 3. [*By kind permission of the* Illustrated London News.

istic of the goddess Ninkhursag in Babylonia and of Hathor in Egypt; clay models of birds, especially the barn-door fowl, which is also found at Ur; pieces of shell inlay, a material and technique particularly favoured in early Sumerian art, to such an extent as to be one of its most notable features. No less striking is the general resemblance of the ruined buildings of the Indus valley to those which lie buried in the tells of 'Iraq.

Correspondences.

The carefully-laid brick walls, paved floors, and drainage conduits, seen on the photographs of these Indian excavations, take us immediately to Babylon or to Ur, with its great paved courtyards and brick drains designed to carry off either the flood-water of the rains or sometimes the blood of sacrifices upon the altar. With the pottery, upon which archaeologists are accustomed to lay great stress, we are bound to proceed cautiously, because a superficial resemblance may easily be misleading, and it has already been mentioned that the discoverers were inclined to see reminders of "Mycenaean" styles. In Babylonia the position of painted pottery is fairly clear; it was not in use at all during the historical Sumerian period, at least, as far back as the First Dynasty of Ur, which, according to native reckoning, was only the third kingdom after the Flood. At some time previous to this—how long previous is very uncertain—the painted ware was made throughout the whole length of the land from Eridu to Assyria, and this has evident connexion with the very early pottery of Susa. What is at least worthy of remark is that, both in India and in the Elamite or Babylonian civilizations, the painted pottery appears to belong to an age which, while not ignorant of metal, was but scantily furnished with copper utensils. It would seem that the increasing use of metal had supplanted the taste for fine painted pottery, for, in the historical period, a great abundance of copper-work goes side by side with a plain and merely utilitarian pottery, with nothing more than a little occasional incised or moulded ornament. Meanwhile, we can at least find a good parallel to the miniature funerary vessels from Mohenjo-Daro in the strikingly similar objects recently found at Ur.

The Problem.

It remains only to ask what conclusions we are entitled to draw from these unexpected discoveries in India and from the comparisons which they evidently suggest, as indicated above. It has been shown that the likenesses, on the Babylonian side, point with considerable unanimity to a particular era in the history of the land, namely, the archaic Sumerian period which may be taken as stretching roughly from 3500 to 2800 B.C. The origin, as well as the racial and linguistic affinities, of the Sumerians has always been a mystery, and certain signs point to their rather sudden appearance in the Land of the Two Rivers at a period unfortunately obscure, but which may possibly be fixed about the earlier of the above dates. It appears that their predecessors were the painted-pottery makers already mentioned, although, as we have no evidence concerning these latter except that pottery, it is not yet possible to decide whether they were actually a different race, or Sumerians themselves in an earlier stage of culture.

(*Continued on page 345.*)

Permanent Photographic Records.

By Fred T. Usher.

Every time the Editor receives a good article accompanied by one or two faded and useless old prints, he wishes that photographic prints were stable. The process discussed in this article is permanent and is of value to all scientific workers, in particular archaeologists whose finds have often to be covered up again.

A VAST amount of photographic record work is going on to-day in all parts of the world. Wherever explorers, excavators and scientists are busy revealing historical and scientific facts for the benefit of the human race, there also are to be found photographers whose responsibility it is to record in picture form the progress of the work. It is a great responsibility, for the results prove beyond the possibility of doubt what the eye has seen, and often more than the eye was able to see, and present it in a way that can be grasped at a glance.

Detail.

Ancient races realized the value of record work as well as we do to-day, but their methods were more laborious though not so convincing nor conclusive. They recognized the value of the picture and made it in their crude ways, and they realized the importance of working in a medium that ensured permanence. Therefore they carved their records in imperishable stone, and to-day, after the passage of thousands of years, we are able to absorb knowledge from those tablets and monuments of the past.

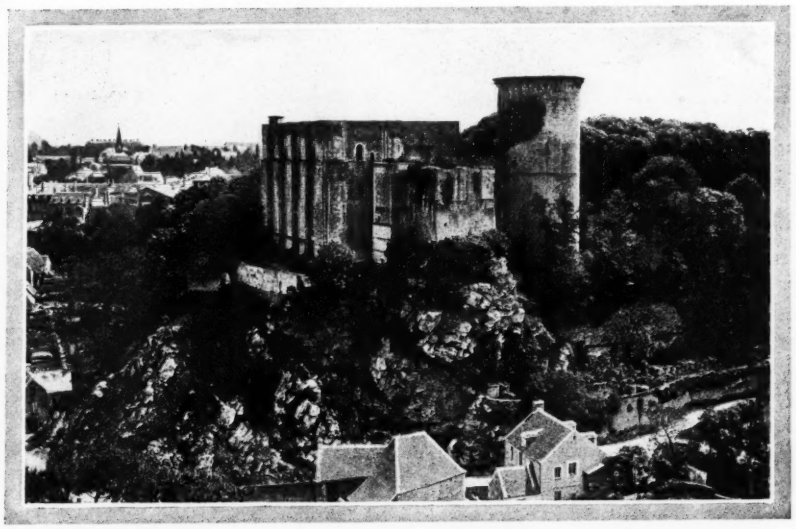
If this town had been destroyed in the war, this photograph, taken many years ago, might have been useful as a guide to the reconstruction architect.

Our modern system of making historical and scientific records is much more perfect and infinitely less laborious. We can, by means of the camera and the wonderful lenses of the period, record what we discover in minutest detail, but whether we are paying sufficient attention to the permanency of our records is open to considerable doubt. The majority of photographs are more or less fugitive even when made with the strictest care, and one trembles to think what thousands of valuable records on photographic papers, now carefully stored for future reference, will be like fifty years hence. Alas, it is to be feared that the images of a large proportion of them must vanish.

It does not follow that the loss will be vital. Fading records may be reproduced by copying from time to time, but that system is not altogether satisfactory for several reasons which could, if necessary, be explained. But the mere mention of the possibility of fading where valuable records are concerned stimulates a train of serious thought.

Undoubtedly, for work of this kind, the most permanent of the photographic processes should be selected, and on running over the gamut of photographic printing inventions one's mind automatically recalls the carbon process which has several qualities to

recommend it as one of the most perfect and enduring, if not the most permanent and enduring, of mediums that we have for record work. There is no known process to-day, and probably never will be, that is capable of reproducing the minutest detail existing in a photographic negative with greater fidelity; there is no known process that is photographically more enduring; and there is no known process that is simpler to work or that will give more satisfactory results in the hands of the inexperienced. Moreover, the results may be retained on paper or, if they are of exceeding value, they may be transferred to more lasting material. One can imagine a photographic record on opal glass or marble remaining in perfect preservation for many generations. The reasons for this happy condition of affairs are not difficult to appreciate when we consider for a moment the basic facts of the process.



Old buildings are often allowed to decay. Carbon prints which record their appearance years ago are extremely useful as a guide indicating where restoration or protection is necessary.

The carbon process has evolved as a result of the scientific fact that gelatine, when impregnated with a solution of a bichromate salt and dried in the dark, becomes sensitive to light. Having been exposed to light in that state it becomes insoluble. If we mix with the gelatine a colour or pigment the gelatine becomes opaque. Now, if we place a sheet of paper, coated with coloured gelatine—which has been impregnated with a bichromate salt and dried—behind a negative and expose it to daylight in an ordinary printing frame, the coloured gelatine will receive the image in positive from the negative. When placed in hot water those portions of the gelatine which have not been exposed to light will dissolve, and those parts which have been exposed to light—the image—will remain insoluble. There is, therefore, left on the sheet of paper an image composed of pure pigment encased in solidified gelatine and so protected from the atmosphere. Thus we have something as perfect and enduring as it is possible for anything photographic to be.

As it is impossible to expose a sensitized sheet behind a negative without a certain amount of light reaching all parts of the sheet, a fine crust of solidified gelatine is naturally formed on the front surface. The gelatine is, therefore, transferred to a temporary support, such as a sheet of glass or opal. The underside of the gelatine is thus exposed to the influence of the hot water, and the surplus gelatine readily floats away. The image, by a simple process, is then retransferred to a clean sheet of paper, cloth, leather, wood, marble or other base as circumstances dictate. In the final image no deleterious chemical action is to be feared and, given ordinary care, records made in such a way should be as imperishable as the base on which the image is laid.

Fortunately, the materials for printing in this old and valuable process are easily obtainable. It has been nurtured and developed for many years by The Autotype Company Ltd., of 74 New Oxford Street, London, who, it is interesting to note, recently reproduced a very fine collection of carbon record prints of the Mount Everest expedition. Pigment plasters—the name given to sheets coated with coloured gelatine—are obtainable in a wide variety of colours, in packets which also include all necessary instructions for working.

There have been several important developments, so that despite its years the process, at one time almost forgotten, is again coming rapidly to the front. Its importance is now being fully realized. By coating the coloured gelatine on celluloid resists for rotary photogravure printing are made, and by transferring exposed pigment plaster to glass or celluloid dia-

positives are obtained, and such dia-positives are superior to those made by any other process because the images, being developed from the back, show more complete gradation of tones than is otherwise obtainable.

Those who wish to take advantage of the process for record work will do well to make their first experiments on pigment plaster ready sensitized by the manufacturers. It must be used within a few days, but a good batch of prints may be run off at one time and waste is thus avoided.

Sensitizing is a simple matter, and if done at night may be effected by the ordinary illumination of the living room. If hung in a dry cupboard plasters will be ready for use the following morning. The sensitizing solution is composed of a pint of water in which half an ounce of pot. bichromate has been dissolved, sufficient ammonia being added to turn the fluid to a sherry colour and no more. A few drops will suffice. The plaster is laid in the solution for three minutes precisely, drained and pinned up to dry or squeegeed on a ferrotype plate and peeled off the following day. Alternatively, a spirit sensitizer may be purchased. After brushing this solution on the plaster it will dry in a few minutes and may be used at once.

Practical Hints.

Apart from its value as a medium for producing record prints its purely photographic attractions are fascinating and the results are as artistically beautiful as they are fascinating.

The following hints may be of use to those who are about to attempt the making of carbon prints for the first time :—

The sensitized carbon plaster is opaque and dark in appearance. Therefore, it is impossible to judge when exposure is complete from a sight of the plaster at intervals as in the case of the silver print, and some other guide is necessary. A rough guide that is quite effective in an emergency can be obtained by selecting a second negative of similar strength and character to the one to be treated. Behind this second negative is placed a sheet of ordinary P.O.P. The two printing frames, one containing pigment plaster and the other P.O.P. are put out to print in daylight. The P.O.P. is examined from time to time, and when it reaches a satisfactory stage of printing the pigment plaster will be ready for development. For more accurate work an actinometer should be purchased. This little instrument, which is not expensive, enables one to fix the exposure for a certain negative and register it for all time.

The image in the pigment plaster should be developed on a temporary support, and such supports can be purchased ready to hand in the form of waxed opal glass or flexible paper. The support is laid in water prepared side uppermost, and the exposed pigment plaster is then pushed under the water, face down. It will slightly curl and at the end of about three minutes flatten out again. Immediately this flattening action takes place the support, and the pigment plaster upon it, are drawn out of the water in close contact. They are then laid on a flat surface such as a sheet of glass and firmly squeegeed with a flat squeegee. In this way all surplus water and bubbles of air are expelled. In twenty minutes' time development may take place. Slide the two sheets under water at a temperature of about 100 degrees Fahr., pigment plaster uppermost. In a few moments coloured gelatine will be seen to be oozing from the sides of the pigment plaster. Now, by raising one corner the paper backing of the plaster can be stripped away. There is left on the temporary support a sticky mass.

Reversed Image.

By gently rocking the water this mass will gradually float away, and a final laving with water will complete development and the image will be presented in all its perfection. A short bath in an alum solution to harden the gelatine and clear away any bichromate stain that has been left, and a wash in clean water are all that is necessary for the present. The temporary support may be hung up to dry.

The image will be seen to be in reverse. We must therefore transfer it to a final support to correct it. Final supports of many kinds can be purchased in the form of double transfer papers. The dry temporary support is immersed in cold water and a sheet of the double transfer paper is laid upon it face down, that is to say, face to face with the image. When the paper lies perfectly flat the two are withdrawn and squeegeed as in the first operation and hung up to dry. When completely dry the sheets may be stripped apart and the image will be seen to have transferred itself to the final support. The temporary support with a little preparation can be used over and over again.

In all photographic printing the depth and beauty of the image is governed by the negative. The best carbon prints are made from a negative that is bright and fairly strong. This should be borne in mind when making the negatives for use with the carbon process.

ROYAL SOCIETY OF ARTS.

UNDER the Peter Le Neve Foster Trust the Council offer a prize of £25 for an essay on "The Effect of Trade Union Regulations on Industrial Output."

Intending competitors must send in their essays not later than March 31st, 1925, to the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.2.

Bird-watching in Autumn and Winter.

Written and Illustrated by M. G. S. Best, F.Z.S., M.B.O.U.

Ducks and Wildfowl are among the most interesting of our winter visitants. Watching them at this time of year is a cold task.

BIRD-WATCHING is a fascinating occupation at any time of year, but during the autumn migration, when there is a general movement of birds from the Arctic to the Equator, or, even farther south than that, the interest is increased to a still greater extent, for at that time there is no knowing what stray visitor may not be met with.

The earliest movement is noticed amongst our own British breeding birds. By the beginning of July Whimbrel are bringing their young families from the moors in the Shetlands where they have nested, to marshland and mudflats by our English shores where food is plentiful, and to be found with little or no trouble. Curlew and Golden Plover follow soon after, and have almost all left their breeding grounds by the time Grouse-shooting begins in August.

The first birds to really leave our shores for their southern winter quarters are the Swifts. These birds are only here a very short time—the last to come, only arriving in May, and the first to go. Towards the end of July small parties may be seen collecting in some sheltered valley near the south coast, waiting for a favourable opportunity to cross the Channel.

Off to Algiers.

I once had the good fortune to watch a flock of Swifts in South Wales, doing their best to make a start. There was a strong gale blowing up the Bristol Channel, a wind that made it a hard struggle to even walk against it. These Swifts had collected in a tiny valley running back into the hills where they could obtain shelter. They hurled themselves out of this valley and made a determined dash for the sea. Time after time they were driven back, carried over the land as helplessly as a heap of autumn leaves. Nothing daunted, they gathered in their little valley again, and once more tried valiantly to get out to sea. Sometimes I thought that one or two birds did not return with the others, and had really got away, but it was impossible to be certain.

This impelling force, urging the birds to start on their journey south, is a very wonderful thing. Go they must, however unpropitious the weather conditions may be. The birds seem to have no power to resist this force, or surely these Swifts, for instance, would not have struggled so gamely with a southerly gale of wind, when, by waiting a day or so longer, they might have had a calm passage.

By September, the whole of our feathered visitors are on the move, and as the month wears on they are in a great hurry about it.

During this month there are many birds arriving day by day that have been breeding in Norway, Siberia, etc. As a rule they travel by night, and may be found in the morning seeking the shelter of some hedge or low-growing bushes, very tired and hungry.

Such a party we found one day in a small wood, after a rough night of wind and rain. The trees were full of Chaffinches and Golden-crested Wrens, only asking to be left alone to rest. But a large flock of Robins had arrived at the same time, and, tired as they must have been, they still showed plenty of that aggressive spirit that characterises this little bird at all times.

Weary Travellers.

The Robins were scolding loudly and doing their best to drive the other birds away. But sheer exhaustion prevented the Chaffinches and Goldcrests from moving another yard, also, there was nowhere else for them to go on the island, as these windswept trees were the only ones there. Next morning the wood was empty again: the birds had one and all departed on another stage of their journey during the night.

Sometimes, but not often, these travellers will arrive by day. Once, in Ireland, we watched the arrival, from early morning to late afternoon, of parties of Wheatears—the Greenland variety, which is rather larger than our own. They came in parties of a dozen or so. Quite fearless, they alighted within a few yards and searched busily for food, paying no attention whatever to us as long as we did not move.

One year, towards the end of September, some fishermen who had been out with their boats in the morning brought in word from the lighthouse-keepers on an outlying group of rocky islands, that the Terns were collecting on the lighthouse rock, which meant that the birds would shortly be leaving their summer nesting-grounds on the adjoining islands.

That evening I was out duck-shooting; a perfectly still night, with no wind, and pitch dark save for the

fitful gleams of the moon. Suddenly we heard a curious sound approaching like several iron hay-rakes crossing a very stony field. When quite close, the din was almost deafening. There was just enough light to see the noise was caused by thousands of Terns, in one vast flock, flying low over the sands to some banks under the shelter of the land. Here they remained for a short while, flying around all day; and then one night they were away to their winter quarters somewhere off the coast of Africa, to return the following April to their nurseries on the islands.

As the winter approaches and October gives place to November, the birds that reach us from the north come to stay, and are not passing visitors. With some, if not all of them, it is merely a question of food supply. The Waxwings, for instance, will only visit us when their own supply of berries in Norway has proved insufficient for their needs. If berries are plentiful there, they stay at home, if not, we get an influx of them. As their visits are therefore only occasional, we hear a great deal about these gaily-coloured little birds when they do come.

The wading birds, those that find their living on mudflats and tidal waters, form a large and most interesting group of birds. This group is almost entirely composed of visitors from the north; very few of them have bred in the British Isles. A few Curlew there may be, Dunlin and Golden Plover, but the flocks of Black-tailed Godwits come from Siberia, as do the Knots, Stints, Grey Plover, etc., which have all dwelt in the region of the Arctic Circle during the summer nesting season.

The Godwits begin to arrive in September. The old birds appear in the most ragged state of plumage, some with a good deal of the colour remaining of the lovely russet breast and neck of their breeding plumage; some, with so many of their flight feathers gone that one wonders how they have managed to fly so far without them.

Canute's Favourites.

When these birds first arrive, they may be found on any sandy foreshore which provides them with the required food and sufficient quiet.

One such shore I know well. Miles of golden sands are left bare by the sea at low water, with deep channels running up between the sandbanks, with enough water left in some of them at low tide to float a punt. A long low island lies about three miles out from the mainland. The northern end is bordered by a line of high dunes, thrown up by the wind, and kept from blowing away elsewhere by a thick tall growth of marram grass which grows all over them. Between this island and the mainland is a wide area of sand and black mud, covered by the sea at high water. On these mudbanks grow large patches of the green zostera, a long grassy seaweed which provides food for countless Duck of all sorts, and the wild Geese that come here in the winter time.

Wigeon begin to arrive in small parties in September. These may be just family parties from the mainland, for they keep separate, each little lot by itself, swimming contentedly about. They are not disturbed by gunners at that time, as there are too few to take out a punt for, and they lie just too far out to get a shot at them from the land.

Later on these Duck arrive in flocks, thousands strong, looking like long trails of smoke against the sky.

Shore Gunners.

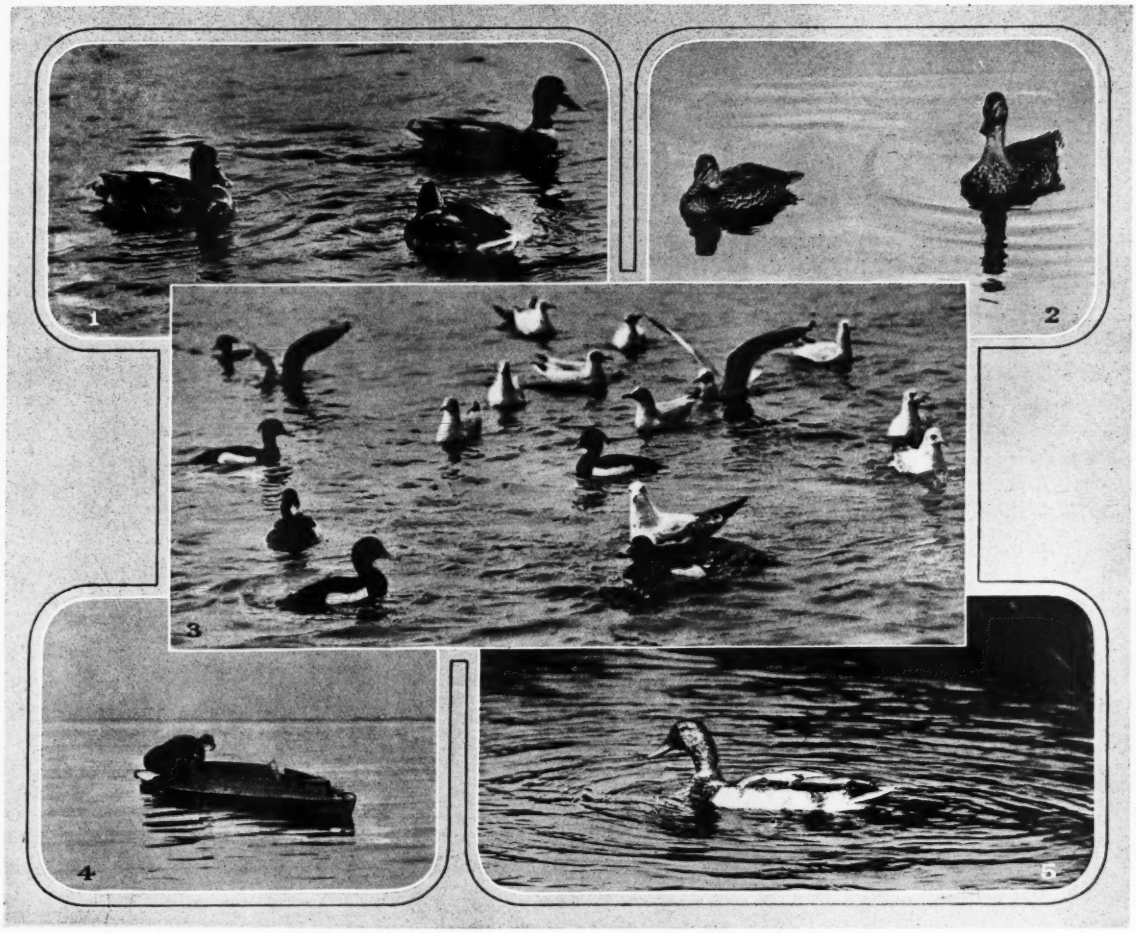
By day, the Wigeon generally lie in the open sea outside the island, especially if they have been shot at early in the morning. They come in to feed at dusk, and it is then that this sleepy little island wakes into life. Each cottage supplies a gun, of sorts. "Of sorts" is used advisedly, for surely a more curious and unsafe collection of firearms it would be difficult to find anywhere else When a particularly reverberating explosion is heard in the stillness of the night, reminding one of an air-raid in the Great War, somebody says, "Ay—that'll be Peter with the ten-bore; he'll have seen some duck" But although this mighty weapon is an object of much pride to its owner, it does not seem to account for so many birds in the course of the winter as do the smaller guns.

Just before dusk, the men depart to a favourite place in the sandhills, collect a few armfuls of marram grass, and make themselves comfortable for a wait of an hour or so, till the birds move in from the sea.

As the light dies out of the sky, it merges in one vast greyness with the sea and shore, only broken by a faint white line at the edge of the sea.

Above the murmur of the waves the voice of a wader, Redshank or Curlew, is heard calling; then even that dies away, and only the whisper of the wind in the grass and the thud of the sea remain.

Suddenly there is a rush of wings overhead and the whistle of Wigeon, and a shot or two from the men in the dunes. Sometimes a figure can be dimly seen scrambling down after a fallen bird, but more often it is left till they go home, and it is seldom a bird



1.—Three Mallard Drakes feeding.

2.—Two Ducks having a siesta. One is suspicious.

3.—Black-headed Gulls and Tufted Ducks. Both are only winter visitors.

4.—Getting the discharged cartridge out of the punt gun.

5.—Mallard Drake changing from the eclipse to the winter plumage. Note the mottled appearance of head and neck.

is lost if they know it's down ; long practice has made them very keen of sight, and they can mark a bird in darkness when it is difficult to see at all.

They tell you that a moonlight night is best for flighting, with a few white clouds blowing across the moon, then it is easy to see the incoming Duck against them, but in a clear blue sky it is impossible, unless the birds fly across the moon.

All through the long winter months these men go out flighting whenever it is possible, lying for hours on these dunes, or on the wet sand below, hoping for a shot. So much depends on wind and weather ; the worse the weather the more likely it is to get a shot, for Duck fly low against a wind.

"By-e-e, but it's chancy work," the men will tell you, and when one has tried it a few nights oneself, one heartily agrees with them.

There are two punts on the island, and one or both are always out after the Duck in any possible weather.

Punt gunning has a fascination all its own, and from the purely ornithological point of view has much, very much, to be said in its favour. Even if luck is against you, and you do not get a shot, the day has shown you many things that could not have been seen otherwise. One remembers with delight the long sandy spit covered thickly with Waders, Godwits, Knots, Plover, Stints and Redshanks, who are so busy feeding on the edge of the water that they do not notice the silent approach of the punt until it has almost passed them.

There is a certain millburn which flows into these slakes from the mainland, a constant stream of fresh water, and here Mallard and Teal may be found if there are any down there at all. For fresh water twice a day they must have, and if it cannot be found on the salt marshes they go inland for it.

In really hard weather, when everything is frozen on the land, Duck are driven off the moors and inland waters and come down to the shore for food. They say they are torpid and slow to move at these times, and so are easier to shoot.

About Christmas time last year there was very hard weather for a week or two. On a certain Duck decoy not far from the coast, the birds used to come in from the sea about four o'clock in the morning. The keeper had to be up by three o'clock to break the ice for them, for if the birds had found the pond frozen over when they arrived they would have gone elsewhere.

Grey Lags.

It was a quiet sunny day when we went there. Mallard, Wigeon, Pintail and Teal were basking in the sun on the open water, or lying tucked up under the reeds sleeping away the hours of daylight. At dusk they woke up to feed, and as we were crossing the marshes on our way home, we heard the quack of Mallard, the whistle of Teal and Wigeon, long before we could see them. A party of six Grey Geese jumped up almost at our feet and flew off towards the sea with a great beat of wings, and voices in shrill alarm. As we moved silently along the banks crossing the marsh, we could see the Duck feeding on all sides. A really hard frost and slight fog are an excellent combination when one wants to see Waterfowl at close quarters.

There are certain coastal areas with wide flat sands and salt marshes, and some tidal estuaries, which form the winter homes of many thousands of Geese. Barnacle and Brent on the estuaries, and Grey Geese—Grey Lag, Whitefronted and Pink-footed, where they can feed on grassland.

To one district on the east coast of England these Grey Geese return every year. For the first few weeks they are found on the stubble fields during the day, flying out to sea to spend the night.

The village folk look for their coming, and give them a warm welcome. Everybody seems interested in the wild Geese and listen for their passing overhead at night. They have a cry like a pack of hounds, and may well have given rise to many of the legends of ghostly packs that are said to hunt an equally ghostly fox at night.

When the Geese have finished all they can find on the stubbles, they come down to the marshes by the sea. A few miles of this land has been drained and converted into excellent meadowland where horses and cattle are turned out to feed in the summer-time. A thick belt of fir trees divides this land from the seashore, and all this long strip is reserved as a sanctuary for the Geese.

Here they feed by day, and even at night if there is a very bright moon, always flying out to sea to sleep. They go out, as a rule, at dusk, returning just before dawn.

Geese are proverbially wary birds, and take nothing for granted. While feeding, they have a perfect system of sentries, who take turn and turn about to watch out. Not content with this, every now and then two or three will fly round high up, to see that nothing is even approaching them from a distance. Their hearing is very acute, and it is said their sense of smell is also. Certainly, if they are approached down wind, they are up and away at once, even if the greatest care has been taken to keep out of sight. This wariness of theirs may arise equally from either cause—it may be from their sense of smell, but it also may be that some slight sound ot movement has been carried to them by the wind, enough to give them warning of somebody's approach.

Smell Sense?

That the sense of smell has something to do with it I have no doubt, as we had direct proof of this with a Grey Lag Goose we were photographing in Scotland.

A small hide was built within a short distance of the nest, from which photographs were taken of her. She always returned readily enough after being disturbed, arranged herself comfortably on her nest, and went to sleep. One day the wind shifted and blew directly from the tent to the nest. The bird came up the hill as usual to within a few yards, hesitated, and left again; nothing would induce her to return as long as the photographer was in the tent. When the wind shifted again the bird paid no further attention to us

Amongst other visitors we have in hard weather are the Swans. They come to us when they are frozen out of their Scandinavian waters. These birds have a most uncanny knowledge of the behaviour of the ice in their northern seas, and within twenty-four hours of the waters being open again, the Swans are off home. How the information is conveyed to them it is impossible to say, but one thing is certain, they at all events do not read the telegrams of shipping information in the daily Press

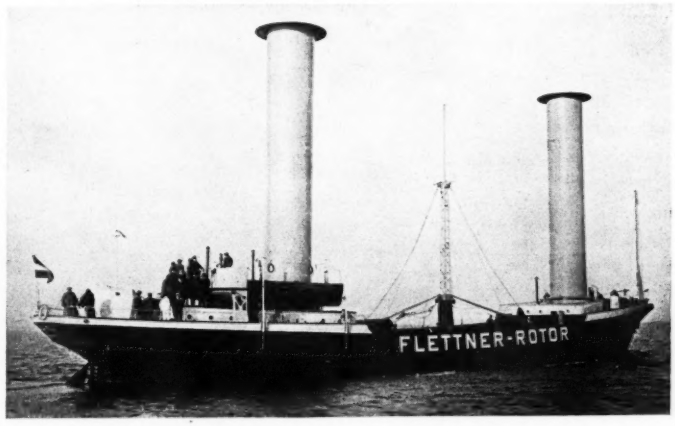
The Electric Wind-jammer.

By Frank C. Bowen.

The white-winged clippers of the past were swift and beautiful, but to-day they are not economic. The Flettner ship sacrifices beauty to utility and may prove to be valuable for certain kinds of freight transport. Its economic value has not yet been proved.

THE ordinary flat canvas sail has long been recognized as a very inefficient means of converting the force of the wind into propulsive power for ships. Efforts to find a better have hitherto followed the lines of the windmill, and French war-time experiments with small boats show that by these means a drive of roughly two and a half times the direct force of the wind could be obtained. But, to judge by the results of preliminary tests, the real solution has been found in an entirely different principle. This is the principle discovered by Magnus in 1853, that a cylinder rotating in a fluid develops a side drift ; as exemplified by the lateral drift of a rifle bullet. Its application to ship propulsion is the outcome of Professor Anton Flettner's study of pressure phenomena, first as a pupil of Count Zeppelin, and more recently as the inventor of the Flettner Rudder.

The "Buckau," the vessel in which Professor Flettner has demonstrated that the Magnus Effect can be utilized practically, is equipped with two tall metal cylinders in place of masts. Each is about 60 ft. high and 10 ft. in diameter, built of thin iron plates. These cylinders are rotated at abont 100 revolutions a minute by means of 9-horse-power motors. When air blows against a stationary cylinder it first piles up on its windward face and then flows away on both sides equally. But if the cylinder is rotated, friction on the side moving in the same direction as the wind is reduced, and the volume of air flowing on that side is greatly increased. A vortex motion is thus caused in the air surrounding the cylinder.



THE FLETTNER SHIP IN THE KIEL CANAL.

The consequence of this vortex motion is that the force of the wind on the cylinder is split up into two component forces, of which one acts in the direction of the wind, and the other at right angles to it. It is this latter component which supplies the motive force. This can be expressed mathematically by the formula :—Force driving ship ahead = A $\sin\theta$ – B $\cos\theta$. The force driving the ship to leeward = A $\cos\theta$ + B $\sin\theta$. As in the case of an ordinary sailing ship, the drive to leeward is resisted by the grip of the hull on the water. Under sail, the nearest a ship can lie to the wind and make progress through the water is 60 degrees. With the Flettner rotors, the "Buckau" "sailed" within about 23 degrees. The flanges which will be noticed at the top of the cylinders are for the purpose of preventing the dissipation of the vortex motion of the air, and similar ones are fitted at the base of the cylinders.

Although Professor Flettner has spoken of the possibility of equipping high-speed liners with his rotors, it is probable that their most profitable employment will prove to be in cargo vessels of moderate or low speed, in which fuel economy is of primary importance.

EMILIUM.

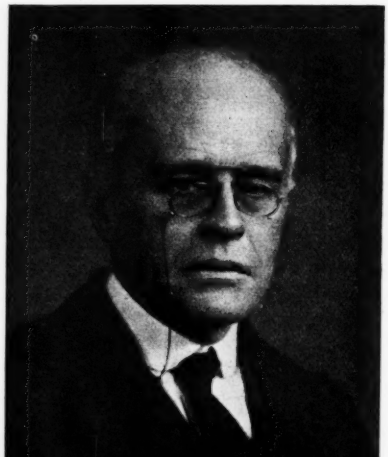
NEW deposits of radio-active material have been found in the Guérat granites near Bagnoles de l'Orne. M. Lorisel claims to have isolated new long-lived radio-active substances from them. To these he has applied the name of emilium.

The Deciphering of Scorched Documents.

By C. Ainsworth Mitchell, M.A., F.I.C.

Mr. Mitchell is recognized as the leading scientific expert in matters of analysis. He has a long experience as an expert witness in legal cases where scientific evidence has been the determining factor.

In the year 1819 Sir Humphry Davy spent two months in Naples, working in the museum there upon scorched papyri which had been recovered from the ruins of Herculaneum, and in 1821 he read a paper before the Royal Society, of which he was then President, upon the methods he had used and the results he had obtained. This appears to be the first account in scientific literature of the examination of documents damaged by fire or heat, and it contains a number of particulars which are of more than ephemeral interest.



C. AINSWORTH MITCHELL, M.A., F.I.C.

In Pompeii, which stood nearer to Vesuvius, the woodwork of the houses was charred, and the remnants of many documents discovered had been burned to a white ash; but Herculaneum had been covered with a fine deposit of hot lava, by which the air had to a large extent been excluded, with the result that there had only been a slow scorching process. The rolls of papyri, which, judging by the characters upon them, must have been ancient at the time of their burial in A.D. 79, had originally been wrapped in parchment. This had become completely carbonized, so that it formed a shiny black deposit. The leaves of vegetable papyrus within the rolls were more or less disintegrated, and varied in colour from pale brown to black, according to the conditions of heat to which they had been subjected, and the degree of permeation of moisture from the moist volcanic ashes. The rolls were tightly glued together and various unsuccessful attempts had previously been made to separate them and decipher the writing upon them.

The method of unrolling found the most successful by Sir Humphry Davy was to attach the animal membrane by means of a glue jelly to the back of the MSS. and then, when the glue was dry, to raise the layers cautiously by means of silk threads. In some cases ether was applied with a brush to separate the layers of leaves; in others chlorine or iodine vapours were introduced, followed by gradual heating, care being taken that the gas was not driven out too suddenly.

Some hundreds of documents had been rescued, but only about 80 to 120 of these were considered worth treating, and the two months' work was expended upon 23 papyri. In the paper published in *The Transactions of the Royal Society* seventeen plates of typical fragments of papyri with writing in Greek or Roman characters are given, and the diagram shown in Fig. 1 is typical of some of these which are written in peculiar characters.

Old Inks.

Advantage was taken of this opportunity for an examination of the inks upon these documents, and tests for iron gall were made by applying a solution of ferrocyanide. Concerning these Sir Humphry observes:—"I looked in vain amongst the MSS. and on the animal charcoal surrounding them for vestiges of letters in oxide of iron; and it would seem from these circumstances, as well as the omission of any mention of such a substance by Pliny, that the Romans, up to this period, never used the *ink of galls and iron* for writing; and it is probable that the adoption of this ink and the use of parchment took place at the same time."

This observation of Davy has frequently been confirmed; the ink in old Egyptian, Greek and Roman papyri always consists of a lampblack pigment, and its successor, iron-gall ink, was not generally used until about the ninth century. The earliest known instance of the occurrence of an iron ink is on a parchment of the seventh or eighth century A.D., which was examined by Mr. A. Lucas (*Analyst*, 1922, XLVII, 9).

Some of the methods used by Davy would have been quite unsuitable for the writing on the papyri

had been done in the more modern type of ink, since the characters would have been completely bleached

Ink which was probably originally composed of an extract of galls mixed with copperas (ferrous sulphate) is found on most of the old parchment documents, although in many cases it has faded to a faint yellow stain due to the organic constituent, tannin, having perished. An analogous effect is produced by the scorching of parchment, when the tannin will be burned away, leaving a residue of yellowish-brown iron oxide, which in some cases may be nearly invisible. Under such conditions the writing may be made legible again by treatment with a slightly acid solution of tannin, when a dark tannate similar to the iron tannate of the original ink will be produced; or the writing may be treated first with very dilute acid, and then with a solution of ferrocyanide, when the iron will react to form a compound analogous to Prussian blue. This is the method used as a test for iron ink by Davy, as mentioned above.

Fig. 1.—SIR HUMPHRY DAVY'S DRAWINGS OF FRAGMENTS OF SCORCHED PAPYRI FROM HERCULANEUM.

Methods.

The application of this method to scorched parchments has recently been communicated to *The Analyst* by Mr. C. G. Matthews (*Analyst*, 1924, XLIX, 516). In one of his cases a parchment document had been placed in a safe. A fire took place on the premises, and, although the safe came through it without much injury, the parchment had been baked to a shrunken scorched brittle mass, which could not be opened without breaking. As a copy of the document was required, it was necessary to treat it so that it could be examined. The best means was found to be by placing it in a covered beaker, with a layer of cottonwool at the bottom to absorb water, and introducing a slow current of steam for half an hour. This gradually softened the parchment and, after standing for a few hours, it could be opened without breaking. It was next brushed with a dilute solution of glycerin to prevent its cracking or drying, and the nearly invisible writing (in iron-gall ink) was then developed by treatment with a solution of gallic acid, so as to form a dark iron gallate similar to the iron tannate mentioned above. The document was thus made legible and the required copy was made.

The extent to which writing on ordinary paper will be rendered permanently invisible by scorching will depend to a considerable extent upon the nature of the pigment and the nature of the paper. If the ink contains a large amount of iron, the characters may often be discerned on the lightly charred fragments and can be brought out more clearly by photography with suitable lighting. Pencil marks can also be seen under favourable conditions, excepting in the case of certain copying-ink pencils, the pigment of which is readily destroyed by heat.

Camden Town Murder.

This point was of importance in the case of *Rex v. Wood*, popularly known as "The Camden Town Murder." A woman was found murdered under sordid conditions, and there was no direct evidence to connect anyone with the crime. The only likely clue was that a number of picture postcards were found in a drawer in the room, while in the grate were some fragments of charred paper. Some of these fragments were collected and preserved between pieces of glass. Portions that had escaped the flame showed writing in a violet copying-pencil pigment, but on the scorched portions the writing was no longer legible. Some of the words on one of the fragments appeared to be in the same handwriting as that on some of the postcards, and a photograph of one of these cards was accordingly published in the Press. The writing was soon recognized as probably that of an artist named Wood, who was accordingly arrested and charged with the murder. On him was found a copying-ink pencil, and it was accordingly necessary to ascertain whether the pigment of this pencil agreed in its characteristics with the pigment on the only fragment which had not been too much injured by the fire for chemical tests to be applied.

The colours of the two pigments matched exactly, both repelled drops of water for a long time, and the drops remained colourless for five minutes; ether

and acetic acid produced similar stains in both, nitric acid gave deep orange stains with both, stannous chloride a dirty green coloration, and nitrous acid a deep bluish-green colour. The pigments in numerous other makes

Fig. 2.—CHARRED FRAGMENTS WRITTEN IN COPYING-INK PENCIL.
(Rex *v.* Wood, Camden Town murder trial).

of copying-ink pencils behaved quite differently in these tests, and there could thus be little doubt as to the pigments in question being of the same character.

For several weeks Wood denied that he had written the characters on the charred fragment, but ultimately he admitted that he had done so. He had denied their authorship because he was aware that it would prove that he was one of the last persons to have been in the woman's company. For the defence he put forward an alibi, and was ultimately found not guilty of the murder.

Redevelopment.

Where the writing on scorched paper is no longer visible (Fig. 3) it is often possible to develop it by cautiously continuing the charring process, so as to burn away the charcoal of the paper and leave a more or less coherent light-coloured ash, upon which the pigment of a black-lead pencil or the iron oxide of an iron-gall ink can then be made out (see Fig. 3). In the case of certain papers the ash will be sufficient in quantity for the purpose; in other cases it is necessary to treat the charred fragment with a solution of a suitable salt, such as aluminium acetate of thorium nitrate. The principle is the same as that utilized in the preparation of incandescent gas mantles, in which the vegetable fabric is soaked in a solution containing mainly thorium nitrate, and then, when burned, leaves a mineral skeleton of the fabric.

Charred paper, after this treatment, will often yield striking results when the burning process is carried a stage further, so that a completely coherent ash is left. Thus, the blacklead or graphite in a pencil pigment, being much more difficult to burn away than the carbon in charred paper, remains as a dark mineral residue on a white background (Fig. 3).

As printing ink also usually contains iron, it can frequently be discerned on partially charred fragments, or developed by heat as described; but it is often necessary to stop the calcining process at the exact point when the writing has been rendered visible. Fig. 4 shows an example of charred paper with printed matter, part of which is nearly invisible, whilst the other part has been developed by heat.

Recent Case.

A case in which these methods were required came within the writer's experience some months ago, The cashier of a business concern was burning a mass of waste papers. He was interrupted in the course of this to make a payment, and instead of replacing the banknotes at once in the safe, left them on the top of the desk, where they became covered by a sheet of paper. His attention was again called off, and then, quite forgetting the notes, he resumed his bonfire and burned them with some other papers. When he discovered his loss it was too late to rescue any portion of the notes, and the grate was full of charred fragments upon which it was hardly possible to discern anything. As there were some reasons for doubting his honesty, his story was not believed, and he was charged with the theft. He persisted in his statement, however, and the writer was asked to examine the charred fragments to see whether they afforded any corroboration of his story.

A systematic search of the mass of charred material was made, some thousands of fragments being examined in oblique light, and the most likely pieces were developed by heat as described. The search revealed portions of destroyed letters, printed notices, fragments of the leaves of a time-table, the remains of telegram forms, and pencilled entries in a cash account, but it seemed improbable that any portion of such material as banknote paper should have escaped. Yet, eventually, buried in a mass of other scorched debris, certain fragments were discovered which could be unmistakably recognized as parts of banknotes, some of them showing a portion of the figure and surrounding pattern in the medallion of the design. Evidence was given to this effect and the defendant was acquitted.

Apart from such methods as development by heat and chemical treatment, a photographic method

of deciphering writing on charred documents was devised two years ago by Mr. R. Davis. It is based upon the fact that the charred paper emits vapours which will fog a photographic plate, whereas the ink in the written or printed characters affords some protection against the vapours. Hence, if the charred fragment be fixed, face downwards, upon a photographic plate, and the plate developed in the usual way after a week or two, those parts of the negative in contact with the characters will appear white on a black background.

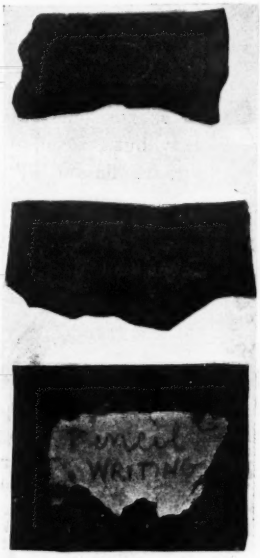


Fig. 3.
TOP.—Charred fragment on which is writing in ink and pencil (invisible).
CENTRE.—Writing in ink developed by heat.
BOTTOM.—Pencil writing developed by heat.

Experiments made by the writer have shown that much depends upon the degree of charring to which the paper has been subjected. If the burning process has only proceeded a little way, so that there is a good deal of organic matter still present, the action of the charred material is more rapid and complete, but if the charring has nearly reached the ash stage, the reaction is very slow, and even after the fragment has remained in contact with an extra-rapid photographic plate for more than ten days, only a very faint image of the writing in ink will be produced.

Fig. 4.—CHARRED FRAGMENTS OF JOURNAL showing printing with developed black on white ash.

The action of carbonized material on a slow plate, such as the ordinary " process " plate, is much slower than on a rapid plate, even in the case of charred paper which still contains much carbonaceous material, and a contact of at least twice the duration must then be allowed.

Another limitation to the use of the method is that the vapours from the char which cause the fogging of the plate are much more active when the paper has been recently burned than after it has been exposed to the air for some time. It is probable that the vapours which cause the fogging contain hydrogen peroxide or some organic peroxide formed in the burning of the organic matter, and if this is the case, we have an explanation of the reduction in the intensity of the reaction, since these compounds will tend to disappear by volatilization on exposure.

Hence, although this new photographic method may give valuable help under favourable conditions, it cannot replace the method of calcination, since it is much too slow for the purpose of ordinary examination and, as has been pointed out, is limited in its applicability.

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RENEWED INTEREST IN AMERICAN OIL SHALE DEPOSITS.

THE Presidential Oil Shale Commission of the U.S.A. Government has directed attention recently to the value of the naval oil shale reserves of 45,000 acres in Colorado and 86,000 acres in Utah, with the result that the Federal Budget Bureau has authorized a fund of 90,000 dollars to be devoted to an investigation of the possibilities of these finds under the U.S. Bureau of Mines. These fields are generally acknowledged as being among the most valuable of the American Government's reserves and the action of the Federal Budget Bureau is regarded as likely to be the beginning of a renewed interest by the public in oil shale.

The Chemistry of the Christmas Pudding.

By Helen Masters.

Dept. of Household Science, King's College for Women.

Chemistry is important, but when it comes to puddings good cookery is the really vital essential. As you will learn from this article, our traditional dish defeats the scientist.

THE old rhyme which tells us that

" Turkeys, carp, hops and beer
Came into England all in one year,"

does not, unfortunately, supply any information on the subject of the Christmas pudding.

This dish is thought by some to be of Teutonic origin, but there is a considerable amount of evidence to show that " plum pottage " or " plum porridge " formed part of the bill of fare of an English Christmas dinner in quite early times. Although this concoction was apparently served as one of the preliminary courses of the meal, it would seem by no means unlikely that the Christmas pudding is a *later* modification, both in regard to time and place in the menu of the older national dish.

At any rate, by the time of the Commonwealth plum broth had attained sufficient prominence to incur the disapproval of the Puritans :

" Plum broth was Popish, and mince pie—
Oh, that was flat idolatry."

Looking at it from a Puritan's point of view there may have been some justification for this attitude, since we know that in more recent times there has generally been a good deal of ceremony almost amounting to ritual connected with the preparation and serving of the Christmas pudding.

Ritual Observance.

It is a time-honoured custom that each member of the family, or household should take a turn at stirring the pudding, and this used to be regarded as a propitious occasion for the granting of wishes, or as a means of securing good fortune in the ensuing year. It is also traditional that on Christmas Day the pudding should be served surrounded by flames. This, it has been suggested, is a relic of the fire-worship with which our Pagan ancestors celebrated the return of the sun at the midwinter festival.

Plum porridge, or pottage, appears to have been composed chiefly of plums mixed with cereal in the form of groats or barley, and butter.

In the Christmas pudding dried fruits such as currants, raisins and sultanas have taken the place of the plums, whilst the cereal used is wheat, either in the form of flour or breadcrumbs, and butter has been replaced by suet. These form what may be regarded as the basis of the Christmas pudding, as we know it, but they are supplemented by the addition of numerous flavouring substances such as sugar, candied peel, lemon, chopped almonds and spices of all kinds. These dry ingredients are bound or mixed together with eggs, additional liquid such as milk and alcoholic beverages, e.g., wine, spirits or ale, being used to bring the mixture to the right consistency.

Success is largely dependent on thorough mixing to secure the even distribution of the many and varied ingredients, and it may well have been the crafty cook, seeking to delegate the labour involved in this operation, who originated the custom of family co-operation in the matter ; the " wishes " no doubt acting as an inducement to ensure that the rite was duly performed by all.

Texture.

In preparing pudding or cake mixtures the question of texture is quite as important as that of flavour. Such mixtures are usually aerated or rendered porous either by the introduction of a considerable volume of air which, on heating, expands and so inflates the mixture, or by the addition of a raising agent by means of which carbon-dioxide is liberated in the mixture, and performs the same function as the air.

In the case of the Christmas pudding air is incorporated by means of the eggs in which a considerable amount of air can be entangled by beating. Most recipes recommend that the eggs should be beaten up and added one at a time. This will facilitate the even distribution of the air-retaining medium.

If it should be necessary, for reasons of economy, to reduce the number of eggs, a chemical raising agent, or baking powder, which usually consists of bicarbonate of soda and tartaric acid or cream of tartar mixed with starch, may be added; or a " self-raising " flour, i.e., flour with which the raising agent (bicarbonate of soda and acid) has already been mixed, may be used.

The presence of fat is also of importance in this connexion, since it assists the formation of minute air and water-tight cavities in which the air in the mixture can be retained and expanded.

With proper manipulation pastry can, for example, on this account be prepared from flour, fat and water without the addition of eggs or other raising agent.

The use of breadcrumbs in preference to flour tends to make the mixture more porous, but flour can perhaps be more easily mixed in with other ingredients.

No exact data with regard to the heat-conducting power of Christmas pudding mixtures are on record, but from our knowledge of the nature of the constituents, it is safe to say that the mixture will be a poor conductor of heat.

For this reason a somewhat prolonged period of cooking by exposure to boiling water or steam is necessary. It is essential that the mixture should be raised throughout to and maintained for a considerable time at a temperature sufficiently high to bring about, in the presence of moisture, the gelatinisation of the starchy material and adequate swelling of the fruit.

Keeping.

Even after this treatment the pudding is not considered to be ready for eating, but it is usually prepared and cooked some weeks before Christmas in order that time may be allowed for " mellowing."

The marked and characteristic taste and odour of different spices and of other substances used as flavouring agents can, in most cases, be traced to the presence in these substances of small quantities of highly-flavoured *essential* or *volatile* oils. On keeping a mixture, such as a Christmas pudding, containing a number of flavouring agents the gradual diffusion and mixing of the various volatile oils tends to produce a blended flavour which is, if the flavouring agents have been skilfully selected, more pleasing to the palate than that of the freshly-cooked mixture. This diffusion of flavour occurs in a more noticeable manner when a strongly flavoured food, such as an onion, is stored in a tin with a piece of bread. The bread after a time acquires the distinctive flavour of the onion.

In some families the pudding served on Christmas Day is one which has been kept over from the batch made in the previous year, and in this case the addition of some alcoholic liquid in preparing the pudding is advisable, on account of the preserving action of the alcohol.

When the great day at last arrives the pudding has first to be reheated and, since its heat-conducting powers will not have increased by keeping, care should be taken that the time of heating is long enough to raise the pudding to a uniform temperature throughout.

After it has been transferred to the dish on which it is to be served the pudding is sprinkled with castor sugar, and just before its introduction to the festive board brandy is poured over and then ignited.

The burning serves to bring out the aroma of the brandy and, by the incipient charring of the sugar, the pleasing and characteristic flavour of slightly burnt sugar or " caramel " is often produced.

It is the function of the food chemist to examine and analyse various food products in order to decide whether or not the composition is such as might reasonably be expected for the particular product in question. Determinations can be made of the principal food constituents: protein, fat, carbohydrate, water and mineral matter. The results thus obtained are compared with those given by average or typical samples of such a food and, in the case of many of the more important foods, standard or limiting values for the principal constituents are drawn up to which the sample under examination, if normal, is expected to conform.

Food Value.

From such an analysis also the number of heat units or calories which will be furnished to the body when the food is digested, i.e., the calorific value of the food, can be calculated.

If chemical analyses were made of a number of different Christmas puddings it might be possible to draw up standards for protein, fat, etc., to which all Christmas puddings could reasonably be expected to conform, but it is necessary to point out that it would also be possible to prepare mixtures whose constituents came within the prescribed limits, which would have no resemblance whatever, except in respect to chemical composition, with a typical Christmas pudding.

From the moisture content some idea of the relative dryness or moistness of different puddings could be obtained, but apart from this chemical analysis does not afford any means of measuring such important culinary factors as texture and flavour. Since Christmas pudding is hardly to be regarded as forming part of our regular diet its calorific value has no particular significance; few people are likely to be interested in this aspect of the subject on Christmas Day.

We must admit then that on the whole a chemical analysis of a Christmas pudding would yield little information that was likely to be of practical value to the cook.

It not infrequently happens, in cases such as this, where the chemical composition of a food is of relatively little practical importance, that the assistance of the chemist may yet be required to detect the presence of harmful or fraudulent adulterations and preservatives. In this respect such a complex mixture as the Christmas pudding would present a by no means simple problem.

Differences of opinion might conceivably arise as to which fruits and flavouring agents should be regarded as allowable. In some of the recipes given for "inexpensive" or "economical" Christmas puddings the use of chopped apples or even in some cases of carrot as a substitute for a portion of some of the more expensive dried fruits is suggested. The proportion of silver, as coinage, or in other forms which might be legitimately added would have to be considered, and also the question whether or not small china dolls and other similar objects should be classified as "foreign bodies." It should also be noted in this connexion that the taking of a representative sample for the purpose of analysis might prove a matter of some difficulty.

The assistance which the chemist can render to the cook in the preparation of the Christmas pudding is limited then it would seem to supplying an explanation of and to some extent controlling the methods which should be used in the mixing and cooking of the pudding, though in some cases the examination of certain of the raw materials, e.g., spices, etc., for adulterants might be usefully undertaken.

There may be some who will think that this is rather a deplorable state of affairs, but it should be remembered that the art of cooking dates back to prehistoric times, and that the cook has had a very long start over the chemist. We are now only just beginning to consider cooking from the scientific standpoint, and to try to formulate the principles on which the various processes used in cooking should be based.

Realizing that it is along these lines that real progress is most likely to be made, and that the future development of this important branch of applied science is largely in his hands, the chemist will no doubt be able to enjoy his Christmas pudding unperturbed by the thought that the "proof of the pudding" is still mainly "in the eating," not in the chemical laboratory.

Asteroid-hunting.

Dr. Baade's New Capture and Its Possible Significance.

[Though at the time of going to press the orbit of the new planet discovered by Dr. Baade has not been completely determined, its resemblance to Eros suggests that it may prove of considerable astronomical significance. This article tells of asteroid-hunting and its history, and also explains the possible importance of Dr. Baade's new capture.]

At first it was not certain whether the interesting object discovered by Dr. Baade, of the Hamburg Observatory, on 23rd October was a planet or a comet, but the Royal Observatory, Greenwich, has now decided that it is a planet. Though at the time of writing the arc of observation is still too short to deduce a trustworthy ellipse, it seems most probable that its motion could be represented by an orbit not unlike that of Eros, and if this be so, the planet may prove of considerable astronomical importance. Eros, as is well known, provides the best possible means of finding the distance of the sun (and hence the dimensions of the whole solar system), but unfortunately, it only makes its nearest approaches to the earth's orbit at very long intervals. If, therefore, the new planet proved of equal utility to Eros in this respect, it would mean that the yard-measure of astronomy could be taken more frequently and also that the results attained by the use of the two separate planets could be used as a check upon each other.

In saying that a new planet has been discovered it will, of course, be understood that reference is made, not to the eight giant planets, but to the innumerable minor planets or asteroids lying between the orbits of Mars and Jupiter. As is well known, the gap between the orbits of these two planets is a very big one, and when Bode's law was announced it was seen to be a strange breach of it that this area should be empty. The law in question may be simply stated. If we write down the series of numbers 0, 3, 6, 12, 24, 48, 96 (every number except the second being double that preceding it) and add four to each, we get the series 4, 7, 10, 16, 28, 52, 100. These numbers, for some reason in no way physically explained, represent the approximate relationship in which the planets actually lie in distance from the sun, except that no planet could be found for number 28; and so strange was this single exception considered that, at the end of the last century, a number of astronomers, convinced that a planet must lie between the orbits of Mars and Jupiter, decided to make a united effort to find it. Their method of search was in theory simple. It was to continually take small areas of the sky in the region of the ecliptic (in which plane all the planets were known to lie), to have a chart of all the stars in each of these areas in front of them, and then to search for

any additional body that might appear in the particular area under inspection. Needless to say, the process proved in practice a most laborious one; for the stars in many regions are very thick and asteriods to all appearances are almost precisely similar to stars. But on 1st January, 1801, Piazzi, an Italian astronomer who had a little observatory in Palermo, Sicily, was rewarded for the extraordinary perseverance he had displayed; for, on commencing for the 159th time to observe new successive areas, he found a new star of 8th magnitude in the constellation of Taurus. Further examination showed the body to be moving, and after a few days' observation it was found that the little orb, afterwards called Ceres, revolved round the sun in the vacant patch between Mars and Jupiter. Three similar bodies—Pallas, Juno and Vesta—were also added to the solar system in the next seven years, and by many it was then considered that no further discoveries would be made in the area. But such did not prove the case; on the research being resumed forty years later, planet after planet was found in rapid succession, and asteroid-hunting became a regular astronomical sport. With the introduction of photography in 1890 the sport became much easier, moreover. The astronomer, instead of using star charts, would simply take a telescope so mounted as to neutralise the effect of the earth's rotation by its movement, place his camera at the end of it, and then photograph the stars with an exposure of about half an hour.

Photography.

The stars proper would be taken on the negative as small round dots; but if a planet happened to be amongst them it would naturally be moving, and its picture would appear, not as a dot, but a short line. Thus, instead of scanning the heavens with his chart, all the observer had to do was to search his plate for a trail, and this was naturally a much easier process. Indeed, so many captures have been made by this process that the once so-thought vacant area between the orbits of Mars and Jupiter is now known to be literally thick with asteroids, and though the sport naturally grows more difficult as the game get rarer, even of recent years further additions have frequently been made. In all a thousand such asteroids of varying sizes have now been discovered and their orbits determined. Of these, Ceres, Pallas, Juno and Vesta alone show measurable discs even in the largest telescopes. These four planets are estimated by Barnard to have diameters of 485, 304, 118, and 243 miles respectively; but the great majority, judging from the amount of light they reflect, must be altogether smaller—so much so that, in the case of the average, 100,000 such bodies would not equal the size of the moon. Certainly it would be a strange experience to spend a short time on one of these little orbs, did conditions permit it. On a minor planet eight miles in diameter, for instance, gravity (assuming the substances of the planet were similar to those of the earth) would only be 1/1000th part the gravity of the globe we inhabit, and this would mean that a man capable of lifting one cwt. on the earth would, with similar exertion, lift 1,000 cwt. on the minor planet.

Local Conditions.

Again, the same fundamental change would have a valuable restraining influence on our habit of throwing things about. It is possible to show mathematically that a body shot off at the rate of six or seven miles a second would be conveyed entirely away from the gravitation of the earth, but on a planet such as the one we are considering the same effect could be produced by a speed 1/1000th part of this, or in other words, about thirty feet per second. Now, since to throw a ball fifteen or sixteen feet high a child has to give it this original velocity, it is clear that every article thrown by an adult must easily exceed it. Accordingly, whenever a man on one of the minor planets threw a handbrush, chair, or whatnot at his wife, it would fly off into space never to return, and one can readily conjecture that, were it possible for us to live on such a planet, domestic furniture would soon grow very rare.

With a family of 1,000 asteroids now collected, it will be understood that it is exceedingly difficult to keep them all under observation, and it is this as much as the increasing rarity of the objects pursued that makes new captures like Dr. Baade's so difficult a matter at the present time. But once an astronomer has made a find, and convinced himself that it is not a previously discovered one, he makes the announcement to his fellow astronomers, and they then proceed to determine its orbit. Now, as is well known, every planet describes an elliptical orbit, one of the foci of which is the sun; and mathematically it can be demonstrated that, once three positions of a planet are known, then the ellipse in which it moves is completely determined. Having, therefore, seen the planet on three occasions, and on each occasion accurately measured the place it occupied, the astronomer, without further observation, can tell the place where the planet will be on any special occasion some months in the future. He may, it is true, lose it with his telescope, but mathematics will tell him exactly where to look for it at any particular time, for its orbit is definitely determined in accordance with mathematical laws.

The Imperial Institute and School Museums.

By H. M. L.

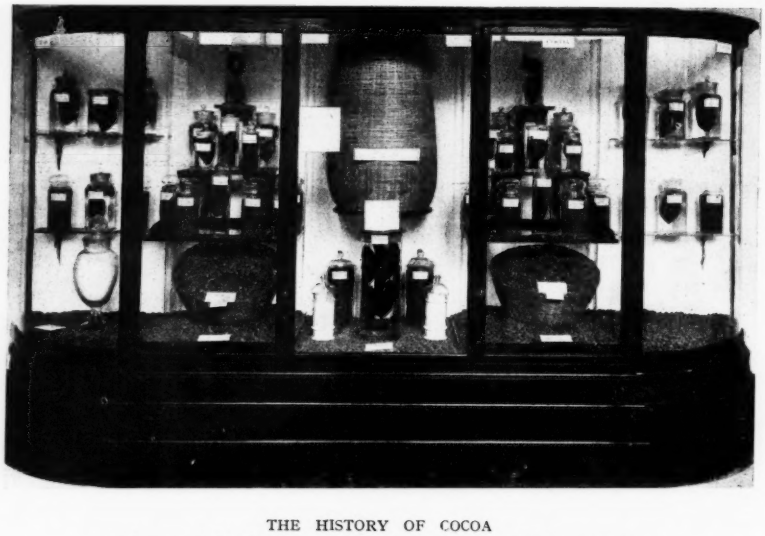
One is continually coming across little-known activities of great public institutions. The Imperial Institute, which will attract many visitors during the winter holidays, has a very important branch which does excellent work helping to familiarize young England with imperial products.

AMONG all the visitors who have flocked to the wonders of Wembley during this summer, possibly the most enthusiastic have been the countless school children, who have travelled by train and coach from every quarter of the Kingdom, and it will be a matter for earnest effort on the part of their teachers that the vision of the Empire and its resources which has thus been opened to the rising generation shall not be lost, but take body and become in some sort a permanent part of their thinking.

In considering the practical aids towards this very desirable end, the facilities offered by the Imperial Institute should not be overlooked. So far as schools in and around London are concerned, the Imperial Institute is available as a kind of condensed and permanent Wembley under one roof. Its galleries, arranged on a geographical system and covering all British territories, are designed to present a mirror not only of the economic side of the Empire overseas, but of its life and scenery. In a short while it is confidently hoped that a large number of exhibits from Wembley will be added to the Institute collections and thus very greatly increase their completeness and value from the educational, as well as the business, point of view.

Fortunately there is no need to impress on London teachers the benefits of visits to the Institute. Apart from unconducted visits, which are often made, three lectures are given each day to parties from schools, by the lecturer on the Institute staff, and already more schools apply than there are lectures available. It is hoped to develop this side of the Institute's work even further in the future.

To the teachers in the Provinces, however, who cannot bring their classes up to London for lectures, it will be good news that the Imperial Institute has in working order a system by which they can obtain at a nominal charge, for the formation of school museums and for the teaching of economic geography, specimens of a great variety of raw materials produced in all parts of the Empire overseas. The system is a very simple one. On application by letter to the Director of the Imperial Institute, South Kensington, S.W.7, a comprehensive printed list of countries and their available products is supplied, and from this the teacher can select exactly what he or she wishes in order to illustrate the lessons on a particular country, or to bring home to the children the nature of some of the most important raw materials of industry. The specimens are sent in stout manila bags, labelled and carefully packed. A charge of 1d. each is at present made as a set-off to the cost of handling, and the cost of carriage is also paid by the teacher, but the expenditure at most is trifling in comparison with the advantages obtained. Let us look at a sample box of these little envelopes taken at haphazard. Kauri gum from New Zealand, castor seeds from India, oil palm kernels from Nigeria, acacia gum from Kordofan in the Sudan, graphite from Ceylon, cocoa



THE HISTORY OF COCOA
as demonstrated in the West African section of the Imperial Institute galleries.

beans from the Gold Coast, cotton and jute from India, lead ore from Newfoundland, crepe rubber from Malay, sisal from the Fiji Islands, gold ore from South Africa. The whole Empire in a parcel.

SOME OF THE SPECIMENS.

Every one of these specimens can be made the subject of a little lecture. Sometimes specimens can be used for demonstration or experiment, such as the preparation of microscope slides of the diatoms found in diatomaceous earth from Australia, or the sample blow-pipe analysis of other mineral samples.

Loan Collections.

Together with the list of specimens, the teacher can obtain from the Institute a list of over 200 official publications dealing with the different countries of the Empire under various aspects, such as agriculture, mining, manufactures, etc. Being written for the general public and free from technicalities, these pamphlets are found exceedingly useful by teachers, in conjunction with the actual specimens, in giving the children a clear idea of the various activities of the countries concerned, while most interesting and attractive series of picture postcards are also available to illustrate the scenery, industries, native types, etc., of many of the Dominions and Colonies. Copies of the pamphlets selected are sent by the Institute free of charge, the teacher paying only the cost of postage; the postcards are for sale at the usual prices.

In cases where it is desired to have the means of demonstrating to the children temporarily the products of a particular country, advantage can be taken by teachers of the loan collections which are maintained by the Imperial Institute and circulated in co-operation with the Victoria League. In such cases application is made to the Education Secretary, Victoria League, 22, Eccleston Square, S.W.1, by whom the actual arrangements are made. Each collection is contained in a strong travelling box, and remains at a school for a period of several weeks, the principal of the school refunding the carriage on arrival and of course defraying it on departure of the box. At present the collections (which are in duplicate) cover only the Dominions and India, but it is hoped that additional collections will be made available later for the principal Colonies.

In these ways, small in themselves perhaps but cumulatively helpful, the Imperial Institute, whose main work of testing and introducing to commerce the raw materials of the Empire goes on unseen by the general public, is doing its share in educating young England to appreciate its birthright, and there is no doubt that these activities, which could be largely extended, are bearing good fruit.

THE SUMERIANS AND INDIA.

(*Continued from page 327.*)

There are, however, some indications that the historical Sumerians had not always lived in the plains, but were originally a mountain folk who reached Babylonia from the east or north-east as did the Gutians and Kassites, later invaders of the same land. Dr. Hall has already suggested that the Sumerians have a certain racial resemblance to the Dravidian populations which still dwell in southern India, and has conjectured that the home of these early culture-bringers might be sought even so far east. But in the present condition of our knowledge it is equally possible to assume that the newly-found civilization of the Indus valley was brought in from the west, from that which alone we know as the land of the Sumerians; or else that the two peoples branched out in opposite directions from a common centre somewhere between the two lands in which these remarkably similar objects have now been found. For the present it is sufficient to observe the evidence, and inference may well be left to attend upon fuller knowledge which excavation alone can supply.

Book Reviews.

Athens: Its History and Coinage before the Persian Invasion. By C. T. SELTMAN, B.A. (Cambridge University Press. 42*s.* net).

This important book deserved reviewing by a first-class authority on numismatics. The Editor of DISCOVERY reflected that His Majesty the King of Italy was a recognized authority on this subject, and that the book was a very fine piece of research work and a volume which did the greatest credit to author and publisher alike. He sent it to His Majesty and expressed a hope that he would review it. In due course the following gracious letter was received.

SIR, *London, 25th October, 1924.*

I am commanded by His Majesty the King to thank you for your very kind thought in sending him a copy of the book "Athens: its History and Coinage before the Persian Invasion."

Although it is not customary for His Majesty to express a personal opinion on the works sent to him in homage, I can let you know that he has very much appreciated this publication.

Believe me, Yours truly.

E. PRYOR,

To the Editor, *Italian Charge d'Affaires.*
DISCOVERY,
8, Bouverie Street, E.C.

The Chemical Age Chemical Dictionary. (Ernest Benn Ltd. 16*s.* net).

One of the minor curses of chemistry is its associated jargon. It is one of the inevitable things from which there is no escape. Whenever new processes or theories are made fresh words are needed to describe or define them.

Despite its title this book covers a very wide range of technical terms not wholly confined to chemistry, and it is astonishingly useful. Nobody need now be mystified by the most up-to-date of incomprehensible "communications" to the Chemical Society. The dictionary has at least four full pages of words beginning with "iso," and a tetrahydro julole is no longer a mystery if you have looked up Julolidine.

The book will be extremely valuable to all whose research work also involves wide reading of abstracts from technical reports, and it should be available in every reference library. Further volumes covering all organic and inorganic substances are in preparation.

The Transpiration Stream. By HENRY H. DIXON, D.Sc., F.R.S. (University of London Press. 2*s.* 6*d.* net).

These three lectures dealing with the ascent of sap in plants carries the present theory that the sap rise is due to water tension to the brink of satisfactory establishment. It is probable that experiment will soon definitely settle the question. In the meantime this little work is welcome for its clear presentation of the facts and its record of progress to date.

The Study of Living Things. By E. S. RUSSELL, M.A., D.Sc., F.Z.S. (Methuen. 5*s.* net).

The student of biology who finds that neither materialism nor vitalism afford him a satisfactory solution to his problems may find in Doctor Russell's book an indication of a third philosophy or interpretation through a study of behaviourism. The book is clear and timely and may be a valuable stimulus to research or, rather, to the co-ordination of the results of research and their interpretation on new lines.

Unknown Tribes, Uncharted Seas. By LADY RICHMOND BROWN, F.L.S., F.R.G.S., F.Z.S. (Duckworth. 21*s.* net).

The vogue of exploring has been on the increase ever since Mrs. Rosita McGrath made her trip into the Senussi country. The authoress of this book gives us a very entertaining account of her tour to the Central American coast and leaves one with a keen impression that life there is one long mosquito bite.

The Structure of Matter. By J. A. CRANSTON, D.Sc., A.I.C. (Blackie & Son Ltd. 12*s.* 6*d.* net.)

This can be classed as a really first-rate book. It is a successful attack on the extremely difficult problem of bringing the average middle-aged professional man's knowledge of recent work up to date. It attacks from a new angle, that of the chemist rather than the physicist and, if we may believe that the average graduate of a generation ago knew more of the elements of chemistry than the elements of physics, it makes a rather easier line of approach for those for whom it is intended.

The book is extremely thorough and deals peculiarly clearly with crystal structure and the theory of lattices. Atomic theories as they stand to-day are fully and fairly covered, and two excellent chapters are devoted to the valency theory of Langmins.

The advanced student who is already familiar with much of the subject will find the book invaluable and appreciate its clarity. The beginner will necessarily find parts of it fairly stiff but will, nevertheless, find it far easier to follow than many previous works designed to fulfil the same end. It is admirably illustrated with plates and diagrams and all important references are given in footnotes.

Space Time Motion. By Professor A. V. VASSILIEV, with an Introduction by BERTRAND RUSSELL, F.R.S. (Chatto & Windus. 7*s.* net).

Einstein is tracked back to Pythagoras in this volume, but it is more easily readable than most attempts to translate Einstein's theories into simple language, for it deals with the philosophy rather than the mathematics.

Narcissus, an Anatomy of Clothes. By GERALD HEARD. (Kegan Paul. 2*s.* 6*d.* net).

The author endeavours to trace out some connexion between the spirit of the ages in architecture and clothes of the same period. Shows a total ignorance of woman's greatest interest.

Principles and Practice of Wireless Transmission. By G. PARR, Demonstrator in Electrical Engineering, Finsbury Technical College. (Ernest Benn, Ltd., 5*s.*).

A difficulty which faces all who undertake with enthusiasm a new hobby is that they have to begin in the middle of their subject. Nearly all the books, and all the periodicals which deal exclusively with their subject write mainly for those who are already acquainted with at least the elements of it. This is perhaps most felt in connexion with wireless telephony, which involves much of the most advanced theoretical knowledge

of modern electrical physics for its proper appreciation. And, although it is possible to enjoy a wireless set without very much acquaintance with the theoretical side of the subject, undoubtedly much additional pleasure is given by knowing something of what is behind the modern miracles of broadcasting. This book will be found exceedingly well suited to the beginner; there is very little mathematical argument, and numerous simple diagrams clear up any doubtful points. Every wireless beginner would be well advised to include this inexpensive book in his library.

Quantitative Organic Micro-Analysis. By FRITZ PREGL, D.Sc., Ph.D. Translated by ERNEST FYLEMAN, B.Sc., Ph.D., F.I.C. (J. & A. Churchill. 12*s.* 6*d.* net).

Micro-analysis is a method of analysis which is assuming greater and greater importance as the scientific worker year by year attacks obscure organic compounds which occur in very small quantities. For ordinary methods of analysis at least a minimum quantity of half a gramme of a carbon compound is essential. In micro-analysis twelve to fifteen milligrammes are sufficient, and if the available amount is slightly in excess of this a molecular weight estimation can be added.

The translator has done his work well and as Professor Pregl's book is extremely detailed the result is a sound volume of careful instruction of a subject which is peculiarly dependent on technique.

The actual detail of the construction of the necessary apparatus is given at long length. But when you realise that this book is the result of years of experience, and that the omission of these minute details and the reasons for avoiding or using this or that may be vital to success, the essential thoroughness of the book is apparent. The chapters cover the determination of nitrogen, the halogens and sulphur, phosphorus and arsenic in organic substances; metals in salts, electro-analysis, determination of carboxyl, methoxyl, ethyloxyl and methyl groups attached to nitrogen. A valuable list of researches carried out by these methods and a scheme of work for students are included.

Micro-analysis may prove to be one of the most important weapons for the up-to-date bio-chemist and biologist, and is certainly a subject whose elementary technique should be studied by the up-to-date analytical chemist. The literature connected with the subject is very limited and difficult of access, and this book may be confidently ranked as a standard authority.

Tales from Nature's Wonderlands. By WILLIAM T. HORNADAY, Sc.D., A.M. (Chas. Scribner's Sons. 12*s.* 6*d.* net).

It was a happy day when Doctor Hornaday, who is a very eminent authority on natural history, thought of telling these tales to his three grandchildren and recording them in book form for other children. And he can tell a tale for children. We tried a chapter of the book on one and she pestered for more. We agree with the author's preface "Much may be done in cultivating a sound and healthy imagination, if the owner is caught when young. Every human being should learn to see things with what Hamlet shrewdly called the 'mind's eye.' To the youngster, and also to the oldster, who can take a well-made book of travel and adventure, and with it and his mind's eye *see* the strange land, its wild men and its wild beasts, that bit of the world becomes his! To those who have some imagination, to those who can see with the mind's eye, I say, 'Come on! Let us see what strange and interesting things we can find on our earth to-day, both of the present and the past.'"

It is a delightful voyage he takes us. We learn how the mountain sheep came from mid-Asia to America and how they separated into different species. There is a glorious, if sad, story of the great tragedy of the Californian asphalte lakes which entombed mastodons and sabre-toothed tigers. Palaeontology undergoes a delightful transformation from a dry and bony subject to glamorous children's stories with clear interesting "reasons why," that do not check the action of the story and do not give false impressions. In the tales of present-time pigmy elephants and hippopotami, the fur seal millions, the Dyaks of Borneo and odd deep-sea fish all figure. A sound book to earmark for a Christmas present. It will be read with delight by all under fifteen and over twenty. Those between would also like to read it if they are sure it is not a "kid's book." As the publishers have wisely got it up as an ordinary book and avoided the cover imbecilities usually associated with "books for the young," it can be given to the haughtiest youth without offence.

The Synthesis of Nitrogen Ring Compounds containing a single Hetero-Atom (Nitrogen). By CECIL HOLLINS, B.Sc., A.I.C. (Ernest Benn Ltd. 55*s.* net).

This is an entirely new type of book and one of the utmost importance to all chemists who have to deal either for industrial or research purposes with the synthesis of organic compounds. In a word, it provides in one accessible, accurate and excellently indexed volume a complete guide to all work that has been published. Every page is noted with the references to the original papers, and a complete index of authors as well as subjects is incorporated.

The book is divided into twelve chapters arranged in sections according to the ring closure of the particular synthesis involved, and each chapter is preceded by an introductory section briefly discussing the selection of synthesis methods available for each type of derivative.

The volume cannot, of course, include practical details of methods of preparation, but these can be gathered from the original papers to which references are made. These include not only proceedings of societies and records in journals, but a very exhaustive analysis of patent literature—a source of information all too often neglected. Patent specifications do not always reveal the truth, the whole truth, and nothing but the truth about a process, but they are often illuminatingly suggestive.

The scope of the book is exhaustive and separate chapters cover the Pyrroles, Indoles and Indigos, Pyridines, Quinolines, *iso*-Quinolines, Carbasoles, Acridines, etc. It is to all intents and purposes a vitally important reference book for all chemists, and should be accessible in every university or technical library. The author is to be congratulated on the systematic method he has evolved for the presentation of such a vast mass of important data, and in particular on the absolute up-to-dateness of all the material. It is one of the most important contributions to the library of chemistry that has appeared in recent years.

A. J. M.

Practical Organic Chemistry. By JULIUS B. COHEN, Ph.D., B.Sc., F.R.S. (Macmillan. 6*s.* 6*d.*).

This is the third edition of this well-known little book which is still doing good service. It has been brought up to date by including some new preparations and methods.

Psychology and the Sciences. Edited by WILLIAM BROWN, M.D., D.Sc., M.R.C.P. (A. & C. Black Ltd. net).

In this volume authorities on specialized branches of knowledge discuss psychology in its relation to their own particular science.

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Professor J. S. Haldane, M.D., F.R.S., writes on the relation of Psychology to Biology. Its reference to Anthropology is covered by R. R. Morett, M.A., D.Sc., Logic by F. C. S. Schiller, M.A., B.Sc., Ethics by L. P. Jacks, D.D., LL.D., Theology by Rev. A. E. J. Rawlinson, M.A., B.D., Education by M. W. Keatinge, M.A., D.Sc., Medicine by W. Brown, M.D., D.Sc., and Psychical Research by T. W. Mitchell, M.D.

The result is a book that enables the reader to "place" the new science much more accurately, and which makes one realize how the advances made by the application of the experimental method in psychology have in turn produced important effects in seemingly independent branches of knowledge.

The volume presents a sane reasoned survey of the whole field and can be particularly recommended to the ordinary educated man who wishes to know how psychology stands in relation to modern thought in general.

Trade Routes and Commerce of the Roman Empire. By M. P. CHARLESWORTH, M.A. (Cambridge University Press. 12*s.* 6*d.* net).

The history of Rome as it is usually taught is a boresome medley of wars of aggression and the improprieties of the wealthy classes. Rome is looked on more as a military power than anything. Little by little we are coming to realize that Rome was not essentially a military Empire but above all things a commercial one.

A stable government is as important to trade and general prosperity as sun to a harvest, and Rome was not only a great nation but an extremely prosperous one.

In the past we have been taught to think of the great roads built across Europe by Roman engineers as strategic roads along which armed forces could be rushed to subdue tribal aggressions. In part, perhaps, they were military, but above all things they were arteries of commerce and were planned for commercial invasion rather than purely military work.

Mr. Charlesworth's book gives an extremely interesting and sensible account of Roman commerce and trade with the various provinces and dependencies. It gives us an insight into the vast volume of trade and in many cases throws light on the reasons for certain frontier wars. The Roman merchant no less than the London merchant of to-day is interested in the maintenance of stable conditions, the repression of brigandage individual or governmental, and the protection of those engaged in trade. This policing of the known world was Rome's greatest task and glory. Failure to maintain order led to the decay of trade and the collapse of the Empire.

The chapters are geographically arranged, and it is perhaps natural that the one dealing with Britain should have for us the most interest. Lead working on a large scale was soon developed, as was a good trade in articles as various as hides and fleeces, slaves and hunting-dogs renowned for speed and fierceness. Tin, curiously enough, is not mentioned by Roman authors familiar with Britain. The book is interestingly written and peculiarly readable in style. It can be recommended for general reading as well as for those already interested in archaeological study.

The First One Hundred Years of American Geology. By GEORGE P. MERRILL, Head Curator of Geology, United States National Museum. (Humphrey Milford, Oxford University Press. 27*s.* 6*d.* net).

Somehow the work of pioneers of science is always associated in one's mind with lectures before learned societies in centres of civilization. Here is the record of a century of real pioneering work—the geological mapping of a continent. Much work was done in laboratories, but in the main it is a wonderful record of field work, a great testimony to the scientific worker.

In 1785 there was no recognized science of geology, there were few maps, chemistry was primitive and laboratory appliances were hardly known in America. The interior of the continent itself was unknown, and the political situation was complicated. This note by a geologist in 1793 gives one a vivid idea of what a mineralogist had to face. He was analysing a portion of an "earthy substance" found near Niagara. It was put in vitriol and water for twenty-four hours but was not affected. It was then treated with vinegar but did not effervesce. Then it was exposed to the heat of a blacksmith's forge for twenty-four hours and then found to precipitate with mild fixed alkali. A "taste of limewater" is recorded. Then "as I had neither the nitrous nor muriatic acids nor even caustic fixed alkali, I had it not in my power to make any trials with them."

In 1830 State surveys were initiated and new theories to account for the occurrence of fossils were mooted. There was considerable difficulty in harmonising all phenomena noted with the biblical account of the De'uge. Eleven years later the geological survey of Canada was begun, but national surveys were not established until 1879, which saw the birth of the present United States Geological Survey.

A five-hours' fight with hostile Indians, closing at nightfall, to be renewed at dawn until the Indians were fought off, was a slight incident to a field party in the West. The famous Doctor Haydon was once captured by Indians who, finding him unarmed but for a hammer and some stones, concluded that he was insane and let him go.

The book gives a full record of the lives and work of men who were pioneers in the field, but its main interest is the slow inception, testing and acceptance of theories which are now accepted as commonplaces of fact. It is not only this quality but the author's interesting and effective style which makes the book extremely readable.

THE APPEAL FUND.

THE Trustees beg to acknowledge with thanks the following subscriptions in addition to those already recorded (the objects of the Fund were stated in the August number, p. 181):—

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